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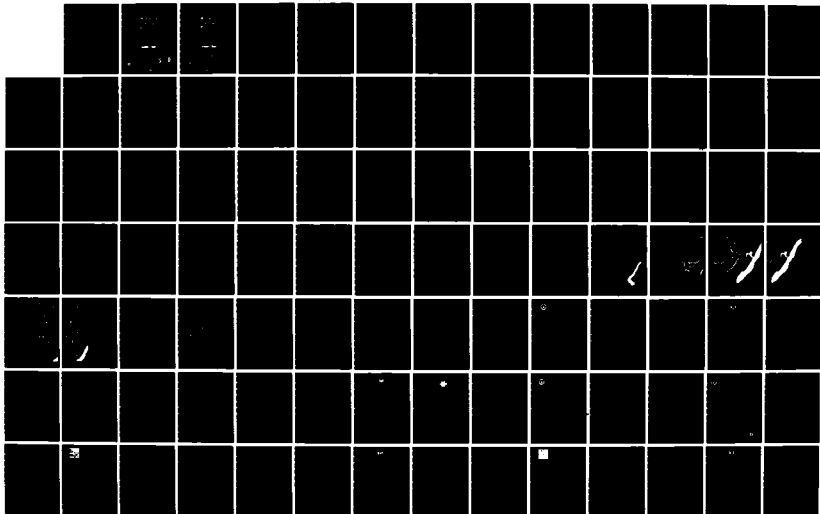
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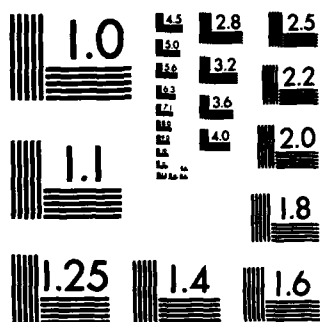
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MAY 1982

CHRISTINA RIVER BASIN  
PENNSYLVANIA AND DELAWARE  
WATER RESOURCES STUDY

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## INTRODUCTION

The Christina River Basin as shown on Plate 1, is located in the extreme southeastern section of Pennsylvania, the northern part of Delaware, and the northeastern corner of Maryland. The Christina River is a tributary of the Delaware River with the confluence at Wilmington, the largest city in the State of Delaware. The major subbasins of the Christina are the Brandywine Creek and White Clay Creek basins and are shown on Plate 2. The city of Wilmington is threatened by tidal flooding from the Delaware River while both Wilmington and the communities upstream in the Christina Basin are subject to fluvial flooding. The primary purpose of this study is to formulate and evaluate plans which would reduce or eliminate the flooding problem in the Basin.

## STUDY AUTHORITY

Recognizing the economic and social problems caused by recurring floods, Congress, at the request of local officials, provided the authority for this study through a resolution adopted by the Committee on Public Works of the U.S. Senate on 25 May 1972. That resolution requested the Board of Engineers for Rivers and Harbors to review the report of the Chief of Engineers on the Delaware River Basin published as House Document 522, Eighty-seventh Congress, and other pertinent reports, with a view to determining whether any improvements in the interest of flood control of both urban and rural nature, navigation, water supply, wastewater management, recreation and other allied purposes, with due consideration to preserving and enhancing environmental values, are advisable in the Christina River Basin. This study also responds to a resolution on Little Mill Creek which was adopted by the U.S. House Committee on Public Works on 9 June 1960. Copies of both of those resolutions are included in the correspondence appendix.

## SCOPE OF THE STUDY

This survey study focused on the evaluation of the flood and related water resources problems in the Delaware portion of the Christina River Basin; identification of the causes of these problems; development of alternative solutions for protecting the floodprone areas and preventing flood damages and loss of life; and determination of the costs, benefits, and environmental impacts associated with implementing these measures.

## STUDY PARTICIPANTS AND COORDINATION

This study was coordinated with the City of Wilmington; the City of Newark; New Castle County; Chester County; State of Delaware; Commonwealth of Pennsylvania; Wilmington Metropolitan Area Planning Coordinating Council (WILMAPCO); U.S. Soil Conservation Service; U.S. Environmental Protection Agency; U.S. Department of Commerce, National Weather Service; U.S. Department of Health, Education, and Welfare; Federal Emergency Management Agency (FEMA); U.S. Heritage, Conservation and Recreation Service; U.S. Fish and Wildlife Service; and U.S. Geological Survey. The study was also coordinated with numerous environmental groups, business interests, and the general public.

An initial public meeting on the Christina Study was held on 22 April 1975 to advise the public about the nature and scope of the study, to open lines of communication, and to identify interested parties and afford them an opportunity to assist in the identification of flood problems and possible solutions. Public meetings on the Little Mill Creek Study were held on 17 April 1968 and 12 September 1972.

The study was initially included in the Corps' Urban Studies Program and much of Stage 1 concentrated on identifying all water resources problems and needs in the Christina River Basin. After extensive coordination, the



Commonwealth of Pennsylvania indicated that its ongoing studies (State Water Plan and COWAMP) in combination with the Brandywine Watershed Work Plan would address all the water resources problems and needs in the Pennsylvania portion of the Basin. Through coordination with the State of Delaware and New Castle County, it was determined that other efforts already underway in the Delaware portion of the Basin (208 Study, State Comprehensive Outdoor Recreation Plan, County Water Supply Study) were addressing all water resources problems and needs except for flood control. This study was coordinated with all other water resources planning efforts in the Basin to insure compatibility between plans developed in the various efforts.

#### STUDIES OF OTHERS

The Pennsylvania Department of Environmental Resources (DER) is developing a flexible State Water Plan for wise management of the water resources to meet present and future needs of the people in Pennsylvania. A draft report on the result of the studies in sub-basin 3 which includes the Christina Basin was completed in September 1977. The final report is scheduled to be completed in 1982.

DER is also developing a Comprehensive Water Quality Management Plan (COWAMP). In southeastern Pennsylvania, COWAMP has been combined with the Section 208 Water Quality Management Plan being developed by the Delaware Valley Regional Planning Commission (DVRPC). COWAMP/208 issued a report on alternative plans and choices in September 1977 and issued their Draft Water Quality Management Plan for Southeastern Pennsylvania in May 1978.

The U.S. Soil Conservation Service prepared the "Brandywine Watershed Work Plan" in 1962 and 1973. The plan includes six flood control and three multi-purpose

reservoirs in the Brandywine Creek watershed (part of the Christina Basin) in Pennsylvania. To date, one flood control and two multi-purpose structures have been constructed on the East Branch of the Brandywine, with two single-purpose structures remaining to be built. None of the planned single purpose and multi-purpose structures have been built on the West Branch. All structures are planned to be completed by 1990. This plan would reduce flood damages by 85 to 90 percent in Coatesville and Downingtown, Pennsylvania, the major flood damage centers in the Pennsylvania portion of the Christina River Basin.

The New Castle County Areawide Wastewater Management (208) Study has been completed and the final plan was submitted to the Governor and U.S. Environmental Protection Agency in April 1977. The study proposed a regional plant solution and deferred non-point source planning which is now being carried out by the Water Resources Agency for New Castle County (WRA).

The State of Delaware completed its Comprehensive Outdoor Recreation Plan in April 1976. In May 1977, New Castle County issued a draft report on solving water supply problems in northern New Castle County (Christina Basin area). This report recommended solution of the problems at a local level. (WRA is currently cooperating with local municipalities and private water companies in the pursuit of solutions to these problems.)

#### REPORT AND STUDY PROCESS

This study was initiated in April 1973. From April 1973 to October 1974 coordination was effected with other agencies and Stage 1 investigations were conducted in order to define the water resources problems and needs of the Basin. Because of the extensive amount of work already underway in the Basin by other agencies, the only remaining unmet water resources need was flood control. Therefore, in order to not duplicate that work, this study's efforts were directed at the flooding problems in the Delaware portion of the Basin.

A Plan of Study was completed in October 1974. It served as a report on the Stage 1 studies, describing the problems and needs of the Basin, defining the scope and direction of the study efforts, and estimating study costs and duration. The Stage 1 studies culminated with the Initial Public Meeting held on April 22, 1975.

The Stage 2 formulation portion of the Study consisted of the exploration of alternative means of solving or reducing existing and future flood problems in the Christina River Basin. Engineering and economic investigations were conducted in Stage 2 in sufficient detail to determine the potential for physical adequacy and technical and economic feasibility. Effect assessments were conducted in sufficient detail to determine socio-economic and environmental practicability. Potentially feasible plans were coordinated with state, county, and local governments to determine whether the plans were desired and would be supported.

Only one plan was found which appeared to be economically justified, implementable by the Corps of Engineers, and initially supported by a non-federal sponsor. This plan was studied further in Stage 3 in order to refine the technical and economic data. Stage 3 studies included work on tidal hydraulics, interior drainage hydrology, pump station design, construction costs, and flood control benefits. These studies were terminated when it became apparent that the non-federal sponsor would no longer support the plan.

This report presents the results of the Christina River Basin Study. Appendix 1 presents pertinent correspondence. The results of the Little Mill Creek flood control study are also included in this report, in order to satisfy the resolution on Little Mill Creek, adopted by the U.S. House Committee on Public Works on 9 June 1960 (The Little Mill Creek flood control

study was completed under Section 205 of the Flood Control Act of 1948, as amended, in response to a request by the State of Delaware, the study sponsor).

## PROBLEM IDENTIFICATION

### EXISTING CONDITION

The Christina River Basin, shown on Plate 1, covers a total area of about 565 square miles, of which about 380 are in Pennsylvania, 177 are in Delaware, and 8 are in Maryland. The Basin includes portions of Chester, Delaware, and Lancaster Counties in Pennsylvania; New Castle County in Delaware; and Cecil County in Maryland. All or portions of three cities (Wilmington, Newark, and Coatesville), nine boroughs, and 43 townships are included. This basin lies in portions of two Standard Metropolitan Statistical Areas (SMSA's): Philadelphia and Wilmington.

The Basin lies in two major geologic regions, the Piedmont Province of the Appalachian Highlands and the Atlantic Coastal Plain. The Piedmont Province includes the northern and largest portion of the Basin while the Atlantic Coastal Plain makes up the smaller southern portion. These two provinces are separated by a fall line which extends roughly northeast to southwest passing in the vicinity of the cities of Wilmington and Newark, Delaware.

The climate in the Basin is characterized as the Atlantic Temperate Zone. There is a relatively long growing season with an average annual precipitation of 45 inches. Localized thunder storms are the major source of precipitation from May to September. Periodically during the summer and early fall months large tropical disturbances, such as "Hurricane Agnes" in 1972, move over the Basin from the south and cause abnormally high precipitation levels and flooding. Annual snowfall averages about 22 inches over the whole Basin.

The land in the Christina River Basin offers a rich variety of natural resources. The Basin's tributaries spawn a great variety of game fish. White Clay Creek, Valley Creek, Beaver Creek, Buck Run, and Pocopson Creek are abundant with trout, while the Brandywine Creek provides warm water bass and perch fishing. Herds of deer and wild fowl are abundant in the upper Piedmont Province. Furbearers, including muskrat, mink, skunk, racoon, and fox, with rabbit dominating, are hunted and trapped in the Basin.

Rich soils and mineral deposits are other natural resources found in the Basin. The active farm land found near Coatesville and Downingtown is some of the richest land in the east. Dairy production and mushrooms are the leading products actively farmed in the Basin. Below these rich soils are mineral deposits of limestone, graphite, iron ore, and a variety of building stone. Limestone and graphite are the only minerals still actively mined in Chester County.

The 1970 population of the Basin was about 412,000. Urbanized areas which lie totally within the Basin include the Borough of Downingtown and the City of Coatesville in Pennsylvania and the City of Newark in Delaware. A major portion of the Borough of West Chester, Pennsylvania as well as most of the City of Wilmington, Delaware, also lie within the Basin. Except for the Coatesville, West Chester, and Downingtown areas, the Pennsylvania portion of the Basin remains mainly rural. As the result of the development pressure from Wilmington, the New Castle County portion is urbanizing at a faster rate. The Basin as a whole is approximately 89 percent rural, 7 percent suburban, and 4 percent urban, based on 1975 land use data.

The civilian labor force of the Basin is about 170,000 people. Most employment is in manufacturing, wholesale and retail trade, and services, which typifies an urbanized area. The largest industrial employer in the

Basin is the chemical industry. Mean family income for the Basin is about 14 percent greater than the average for the entire United States. However, within the Basin there is a large variation in mean family income.

#### CONDITIONS IF NO FEDERAL ACTION TAKEN

If no federal action is taken as a result of this study, the Basin will not remain static. Non-flood plain urbanization will continue, along with its undesirable side effects on storm water drainage. Run-off from paved areas will increase. Flood stages will increase for all fluvial events.

Based on projections made by the Delaware Valley Regional Planning Commission (DVRPC) for Chester County and projections prepared for the New Castle County 208 Study, the population of the two county area will increase from the 390,000 level of 1970 to about 621,000 in the year 2000 and 784,000 in 2030. Most of the growth will take place between Newark and Wilmington and in the areas surrounding Coatesville, Downingtown, and West Chester.

This population growth will bring about corresponding growth in residential, industrial, and commercial development. Based on municipal and regional projections of land use, urban land will increase from 4 to 12 percent of the Basin's area by the year 2000 and to 15 percent by 2030. Over the same period, land in suburban density uses will increase from 7 to 12 percent by 2000 and 14 percent by 2030. There will be a corresponding decrease in rural density land uses such as farming and open space from 89 percent to 76 percent by 2000 and to 70 percent by 2030.

This shift to higher density land uses will result in an increase in the amount of impervious land in the Basin. Rural density development is about 5 percent impervious due to roads. Suburban density development is about 30 percent impervious due to streets, sidewalks, parking lots, and buildings.

Urban density development is about 65 percent impervious due to the same factors. This means that by 2000 the Basin as a whole will increase in imperviousness from 9.2 percent to 15.2 percent and will further increase to 18.1 percent by 2030.

This increase in imperviousness will translate into higher flood peaks and shorter times before the peaks occur. Table 1 shows that peak flood stages generally are increased from 1 to 4 feet due to the urbanization effect. Stages for more frequent flood events are increased to an even greater extent. These increased stages are expected to occur in spite of recent efforts by New Castle and Chester Counties to regulate to some extent the increases in runoff due to new development. The resulting impact on flood damages will be a 46 percent increase in average annual damages by the year 2030.

Table 1  
Effect of Urbanization on Peak Flood Elevations  
100 year flood

| <u>Stream</u> | <u>Location</u>        | <u>Peak Flood Elevation - ft. (MSLD)</u> |             |             |
|---------------|------------------------|--|-------------|-------------|
|               |                        | <u>1980</u>                              | <u>2000</u> | <u>2030</u> |
| Christina     | Rt. 141, Newport       | 11.7                                     | 12.2        | 12.4        |
| Christina     | Nottingham Rd., Newark | 130.1                                    | 133.2       | 133.4       |
| Brandywine    | Market St., Wilmington | 17.1                                     | 18.3        | 18.7        |
| White Clay    | Rt. 7, Stanton         | 17.6                                     | 18.9        | 19.9        |
| White Clay    | Chappel St., Newark    | 72.5                                     | 73.5        | 73.7        |
| Red Clay      | Kaimensi Rd., Stanton  | 27.5                                     | 29.9        | 31.9        |
| Red Clay      | Benge Rd., Yorklyn     | 185.9                                    | 186.7       | 187.3       |

## PROBLEMS, NEEDS, AND OPPORTUNITIES

Flood problems currently exist along the Christina River, Mill Creek, White Clay Creek, Red Clay Creek, Little Mill Creek, Hyde Run, and Cool Run in the State of Delaware and along the Brandywine Creek in Delaware and Pennsylvania. Inadequate drainage facilities in developing population centers have compounded the problem in urban areas. The lower reaches of both the Christina River and the Brandywine Creek in Wilmington are also subject to tidal flooding from the Delaware River. This may occur alone or in combination with fluvial flooding.

The damage centers in the Delaware portion of the Basin are shown on Plate 3. Table 2 lists these damage centers and the average annual damages suffered. The table also indicates which areas are major damage centers. Based on 1975 conditions and an October 1980 price level, the total average annual damages for the Delaware portion of the Basin are \$4,035,000.

Tropical Storm "Agnes" of June 22-24, 1972, was the record event for the Basin as a whole. This storm resulted in flooding at all the flood damage centers in the Basin and was estimated to have caused \$1.5 million damage. However, due to the large areal size of the basin, other more localized storms have resulted in higher flood damages at some damage centers. Therefore, the flood of record for individual damage centers varies throughout the Basin.

Wilmington and its suburbs have been severely affected in the past by floods on the Brandywine Creek. The flood of record on the Brandywine at Wilmington was caused by "Agnes." An area of the city approximately bounded by Governor Printz Boulevard, Claymont Street, Vandever Avenue, and the Brandywine was flooded. The City filtration plant has also been affected by flooding on the Brandywine.



TABLE 2  
Flood Damage Centers

| <u>Number</u> | <u>Stream</u>     | <u>Location 1/</u>                   | <u>Designa-<br/>tion 2/</u> | <u>Average<br/>Annual<br/>Damages 3/</u> |
|---------------|-------------------|--------------------------------------|-----------------------------|--|
| 1A            | Christina River   | Wilmington                           | N                           | \$1,638,000                              |
| 1B            | Brandywine Creek  | Wilmington                           | M                           | 674,000                                  |
| 2             | Little Mill Creek | S. of Elsmere                        | m                           | 7,000                                    |
| 3             | Christina River   | Newport                              | M                           | 18,000                                   |
| 4             | Christina River   | Christiana Acres -<br>Duross Heights | M                           | 159,000                                  |
| 5             | Christina River   | Ivy Ridge-Coventry                   | m                           | 6,000                                    |
| 6             | Christina River   | Christina                            | m                           | 5,000                                    |
| 7             | Christina River   | Smalleys Pond                        | m                           | 5,000                                    |
| 8             | Christina River   | Newark I-95 & Delaware 896           | M                           | 17,000                                   |
| 9             | Christina River   | Newark (Chestnut Hill Rd.)           | m                           | 19,000                                   |
| 10            | E. Br. Christina  | Newark (N. of Barksdale)             | M                           | 51,000                                   |
| 11            | W. Br. Christina  | Newark (Arbour Park)                 | i                           | Not Available                            |
| 12            | Brandywine Creek  | Hagley Museum                        | ii                          | Not Available                            |
| 13            | Red Clay Creek    | Stanton                              | M                           | 166,000                                  |
| 14            | Red Clay Creek    | Marshallton                          | M                           | 263,000                                  |
| 15            | Red Clay Creek    | Faulkland                            | m                           | 0  |
| 16            | Red Clay Creek    | Wooddale                             | M                           | 8,000                                    |
| 17            | Red Clay Creek    | Yorklyn                              | M                           | 76,000                                   |
| 18            | Hyde Run          | Faulkland-Lancaster Pike             | m                           | 5,000                                    |
| 19            | Mill Creek        | Stanton                              | m                           | 2,000                                    |
| 20            | White Clay Creek  | Stanton                              | M                           | 162,000                                  |
| 21            | White Clay Creek  | Harmony Hills                        | M                           | 16,000                                   |
| 22            | White Clay Creek  | Newark                               | M                           | 70,000                                   |

TABLE 2 (Con't)  
Flood Damage Centers

| <u>Number</u> | <u>Stream</u>              | <u>Location 1/</u>   | <u>Designa-<br/>tion 2/</u> | <u>Average<br/>Annual<br/>Damages 3/</u> |
|---------------|----------------------------|--|-----------------------------|--|
| 23            | Cool Run                   | Chestnut Hill Estates-<br>Newark   | m                           | 5,000                                    |
| 24            | Pike Creek                 | Linden Hill Road   | m                           | Not Available                            |
| 25            | Trib. to Naaman's<br>Creek | Talley's Corner  | O                           | Not Available                            |
| 26            | Red Clay Creek             | Barley Mill Road<br><br>Spring Valley Road<br><br>Brackenville Road,<br>(Covered Bridge) | m                           | Not Available                            |
| 27            | Little Mill Creek          | Brack-Ex, Elsmere,<br>Greenville   | M                           | 663,000                                  |
| 28            | E. Br. Christina           | Covered Bridge Farms   | iii                         | Not Available                            |
| 29            | White Clay Creek           | Academy St., Newark  | ld                          | Not Available                            |
| 30            | White Clay Creek           | Louviers   | m                           | Not Available                            |
| 31            | Red Clay Creek             | Prices Corner  | ld                          | Not Available                            |
| 32            | Persimmon Creek            | Arbour Park, Newark  | i                           | Not Available                            |

1/ Location of damage centers is shown on Plate 3.

2/ Designation symbols for the damage centers are:

- M - Major damage center
- m - Minor damage center (damage is minimal in centers where data is not available)
- O - Damage center outside of Christina River Basin
- i - Included in damage center 9 (minor damage center)
- ii - Included in damage center 1B (major damage center)
- iii - Included in damage center 10 (major damage center)
- ld - Damage center outside flood plain; local drainage problem

3/ Damages are for tidal and fluvial flooding under 1975 conditions and an October 1980 price level.

The White Clay and Red Clay Creeks have had substantial flooding in their lower reaches. The greatest damage along White Clay Creek has been in Newark, Delaware. Flood damage in this area has been the result of backed-up sewers, flooded roads, and flooded cellars. The Delaware Park Race Track, located upstream of the confluence with Red Clay Creek, was damaged in the flood of July 5, 1937. This flood had the highest recorded stage at the U.S.G.S. gage east of Newark. High stages on Mill Creek have produced intense flooding at camps in the Hockessin area. On September 12, 1960, hurricane "Donna" produced the greatest flood of record on the Red Clay Creek at the Wooddale, Delaware gaging station. This and other floods have damaged several industries in Yorklyn, Delaware. Some damage has also occurred along Red Clay Creek in the Stanton area.

The Wilmington Marine Terminal and other industries near the mouth of the Christina River have been flooded by high tides on the Delaware River. The storm of November 25-26, 1950, produced the worst flooding in this area, with depths of up to three feet. Homes along the Christina in the Newark area have had backyards and basements flooded on several occasions by fluvial floods.

Two major flood events have been well documented on Little Mill Creek. One, on 8-9 July 1952, took place prior to the installation of the gage. The other, on 9-10 August 1967, is the flood of record at the gage. It was caused by an intense thunderstorm and damaged primarily residential properties in the Elsmere area.

#### PLANNING CONSTRAINTS

The formulation and evaluation of alternative plans including screening of these alternatives must of necessity be constrained by an appropriate set of technical, economic, social, and environmental criteria.

Technical Criteria. The following technical criteria were adopted for use in developing and analyzing flood protection alternative plans:

- . Protection should be provided, if justified, against a design storm equal to the Standard Project Flood due to the urban nature of the area and the threat to life which would be caused by failure of protective works;
- . Protection should be provided as a minimum against a design flood equal to or greater than the flood of record;
- . Protective works should be designed to prevent failure up to the design flood; and
- . Protection must function without causing adverse effects in other areas.

Economic Criteria. The following economic criteria were adopted for the formulation and evaluation of conceptual flood protection alternatives within the Christina River Basin:

- . Tangible benefits should exceed project economic costs to warrant further consideration.
- . Each separate unit or purpose should provide benefits at least equal to its costs.
- . The scope of the development is such as to provide the maximum net benefits; however, some benefits may be foregone to obtain positive non-monetary contributions to the social well-being or environmental quality.
- . There are no more economical means, evaluated on a comparable basis, of accomplishing the same purpose or purposes which would be precluded from development if the plan were undertaken. This criteria refers only to those alternative possibilities that would be physically displaced or economically precluded from development if the plan is undertaken.

Social Criteria. The following social criteria were considered in formulating the plans. Plans should:

- . protect public health, safety, and well-being, including possible loss of life; and
- . reflect acceptance by and desires of the affected communities.

Environmental Criteria. The following environmental criteria were considered in formulating the plans. Plans should:

- . promote the development of pleasing aesthetics and other desirable environmental effects; and
- . avoid, where possible, detrimental environmental effects, and include features to mitigate such effects if they are found unavoidable.

#### PLANNING OBJECTIVES

The planning objectives which guided this study and were used as the basis for evaluation and for measuring the accomplishment of the alternative plans are as follows:

- a. Eliminate or reduce the potential for flood damages and loss of life caused by streams within the Delaware portion of the Christina River Basin.
- b. Preserve streams, flood plains, and critical upstream areas in the Basin and their existing fish and wildlife habitats and recreational and aesthetic values.
- c. Provide for the most cost effective method of solving the flood water problems, and provide net economic benefits both to the citizens of the nation and the citizens of the State of Delaware and the study area.
- d. Be acceptable to the public as measured by overall consensus of endorsement of those plans and/or programs by various Federal and non-Federal agencies and local officials.
- e. Function without causing adverse hydrologic, environmental, or social effects in the study area or its surrounding environs.
- f. Be integrated with and be complementary to other urban development and management programs also being undertaken in the Christina River Basin.

## FORMULATION OF PRELIMINARY PLANS

Plan formulation is a systematic, orderly series of steps undertaken to develop a plan that provides for the best use of water and related land resources to meet the current and projected needs that have been identified for the study area. The formulation process thus involves identification and development of alternative structural and non-structural measures, evaluation and assessment of alternative plans, and eventual selection of the best plan.

### MANAGEMENT MEASURES

Many regional (R) and local (L) flood control measures were considered for solving flood problems of each damage area. "Regional" normally designates a measure which applies to more than one damage reach or area. "Local" usually implies that the measure applies to only one damage reach or area. All the flood control measures which were considered are listed below. R and L indicate what type of measure they are normally considered.

#### STRUCTURAL

Bridge Modifications and Replacements (L)

Bypass Channels (L)

Channel Modifications (deepening, widening and realignments of existing channels) (L)

Drainage System Improvements (L)

Dry Detention Reservoirs (R)

Levees and Floodwalls (L)

Permanent Pool Reservoirs (multi-purpose) (R)

Tide Gates (L)

#### NON-STRUCTURAL

Contingency Flood Proofing (L)  
Flood Forecasting (R)  
Flood Insurance (R)  
Flood Plain Zoning, and Floodway Ordinances, Regulatory Measures (R)  
Flood Preparedness or Disaster Planning (R)  
Flood Warning (R)  
Natural Channel Storage (natural impoundments) (R)  
Non-Flood Plain Regulations (R)  
Permanent Evacuation or Relocation (L)  
Stormwater Management (including upland retention) (R)  
Tax Adjustments or Acquisition of Development Rights (R)  
Temporary Evacuation (L)

#### PLAN FORMULATION RATIONALE

Formulation and evaluation of preliminary plans was carried out in six cycles. The detail of the investigations increased with each succeeding cycle. Cycle 1 began with the consideration of all possible flood control measures and an alternative for no action. All of the possible solutions which were considered to be physically applicable to the situation and technically practical were carried into Cycle 2 without evaluation of cost or benefits.

In Cycle 2 these solutions were evaluated for physical and economic performance. Only those showing adequate physical performance and a benefit to cost ratio greater than 0.7 were carried into Cycle 3. These analyses were based on preliminary costs and benefits.

In Cycle 3 the evaluations of physical and economic performance were conducted at a greater level of detail. Only those alternative plans which eliminated or greatly reduced the flooding problem and indicated the potential for economic justification were reviewed in Cycle 4.

The major effects which each alternative would have on National Economic Development, Environmental Quality, Regional Development and Social Well-Being were tabulated in Cycle 4. A review was made of the magnitude of potential benefits and costs which had not been accounted for in the Cycle 3 economics because they would require more detailed investigations. Water supply and recreation benefits were among those considered. The potential impacts of the major effects and unaccounted for benefits and costs on plan justification were evaluated for each alternative considered in Cycle 4. The recommendations made in Cycle 3 for further study were then reevaluated.

The District's tentative recommendations were then coordinated with all potential local sponsors in Cycle 5. In this cycle some plans were eliminated because of a lack of local support and others were eliminated because they could not be implemented by the Corps of Engineers.

The three plans which passed the implementability tests of Cycle 5 were studied in greater detail in Cycle 6. More detailed physical data was collected and revisions were made to alignments, protection levels, and designs. As a result of Cycle 6, only one plan was found which required further study.

#### ANALYSIS OF PLANS CONSIDERED IN PRELIMINARY PLANNING

Alpha-numeric Notation. An alpha-numeric symbol has been assigned to each alternative flood control solution considered in Cycle 2 or beyond. For



local alternatives, the damage center number is followed by a hyphen and letters representing the type of solution. In addition, damage center 1 is split into reaches, 1A and 1B, to represent considerations along Christina River and Brandywine Creek, respectively, in that damage center. A number is added following the letters if more than one solution of a type is found in the same damage center. The letters represent:

- L - Levee or floodwall
- BM - Bridge modification or replacement
- CM - Channel modification
- BC - Bypass channel
- FP - Flood proofing
- E - Permanent evacuation and relocation

For example, 20-L1 is the first levee/floodwall plan investigated in damage center 20.

For regional alternatives, a letter or letters representing the type of solution is followed by a hyphen and a number. The letters represent:

- R - Reservoir (either multi-purpose or dry)
- FW - Flood Forecasting, warning and preparedness planning
- T - Tidal dam or gate structure
- FI - Flood insurance
- SW - Stormwater management
- FZ - Flood plain zoning
- N - No action

The number indicates which alternative of the type is being referred to. An "A" at the end of a reservoir's symbol indicates that it is dry while a "B" indicates it has a permanent pool (multi-purpose).

Plans Considered. All types of local measures were considered for each major damage center. Those that were found to be applicable in Cycle 1 are listed in Tables 3 through 16. Each table covers one major damage center. All flood control plans except 1A-L2 were eventually found to be either economically unjustified or not implementable. The tables describe each alternative which was considered and indicate during which cycle each plan was eliminated and for what reason. Table 17 gives similar information for the regional alternatives. Three plans, flood forecasting, warning, and preparedness planning (FS-1), storm water management (SW-1), and flood plain zoning (FS-1), were eliminated from consideration in Cycle 5 because the Corps would have no role in their implementation. These three plans, however, show potential for economic feasibility and could be implemented locally.

Plan FW-1 forecasting/warning components would involve not only announcements by the National Weather Service, but would include a self-help forecasting system. The self-help system would involve a precipitation network comprised of 30 observers, located mostly in the upstream areas, procedures for forecasting and arrangements for issuance of warning by officials to the general populace. The plan would adopt existing preparedness planning and facilities developed on a state-wide basis specifically for flood emergencies in the Christina River Basin.

Plan SW-1 involves creation of a basin-wide system of localized retardation/detention measures, to reduce the impact of development on stormwater runoff, through county/state management. Stormwater management considered for this stage of the study consisted of a series of small retarding structures along the Christina River, Muddy Run, Belltown Run and White Clay, Middle, Pike, Red Clay and Little Mill creeks. If this alternative is pursued further by non-Federal interests, additional structures and on-site measures could be considered.

TABLE 3  
LOCAL ALTERNATIVE MEASURES  
DAMAGE CENTER 1A  
CHRISTINA RIVER, WILMINGTON

| <u>Alternative</u> | <u>Type</u>     | <u>Description</u>   | <u>When<br/>Eliminated</u>    | <u>Why<br/>Eliminated</u>       |
|--------------------|-----------------|--|-------------------------------|---------------------------------|
| 1A-L1              | levee/floodwall | earth levees and concrete floodwalls protecting tidal flooding up to 100 year level and from fluvial flooding to an even higher level                        | Cycle 2                       | BCR = 0.5 <sup>1/</sup>         |
| 1A-L2              | levee/floodwall | earth levees and concrete floodwalls protecting from tidal flooding up to Standard Project Hurricane level and from fluvial flooding to an even higher level | Considered further in Stage 3 |                                 |
| 1A-FP              | flood proofing  | flood proofing structures in flood plain up to the 100 year flood elevation  | Cycle 5                       | No local sponsor<br>(BCR = 1.3) |

<sup>1/</sup> BCR is benefit to cost ratio. If less than 1.0 it indicates economic infeasibility.  
BCR's are based on a 7-3/8% discount rate and October 1980 price levels.

TABLE 4  
LOCAL ALTERNATIVE MEASURES  
DAMAGE CENTER 1B  
BRANDYWINE CREEK, WILMINGTON

| <u>Alternative</u> | <u>Type</u>                              | <u>Description</u>   | <u>When<br/>Eliminated</u> | <u>Why<br/>Eliminated</u>                  |
|--------------------|--|--|----------------------------|--|
| 1B-L               | levee/floodwall                          | earth levees and concrete floodwalls protecting from flooding up to the 100 year elevation (tidal or fluvial, whichever is greater) 1/ | Cycle 6                    | BCR = 0.7                                  |
| 1B-CM1             | dam removal                              | removal of Dam No. 1, an unused masonry structure  | Cycle 2                    | BCR = 0.1                                  |
| 1B-CM2             | channel deepening                        | deepening the channel from the confluence with the Christina River up to the Jessup Street bridge                                      | Cycle 6                    | 75% residual damages too great (BCR = 1.5) |
| 1B-BM              | channel deepening & bridge modifications | channel deepening described for 1B-CM2 in combination with modifications to the Governor Printz Boulevard and Jessup St. bridges       | Cycle 3                    | incremental BCR < 1.0 (BCR = 0.8)          |
| 1B-BC              | bypass channel                           | diversion of Brandywine Creek near Fort Christina  | Cycle 2                    | BCR < 1.0                                  |
| 1B-FP              | flood proofing                           | flood proofing structures in flood plain up to the 100 year flood elevation  | Cycle 2                    | technically infeasible                     |

1/ Protection level changed to Standard Project Flood in cycle 6.

TABLE 5  
LOCAL ALTERNATIVE MEASURES  
DAMAGE CENTER 3  
CHRISTINA RIVER, NEWPORT

| <u>Alternative</u> | <u>Type</u>    | <u>Description</u>  | <u>When<br/>Eliminated</u> | <u>Why<br/>Eliminated</u> |
|--------------------|----------------|---|----------------------------|---------------------------|
| 3-L                | levee          | earth levee protecting from tidal flood-<br>ing up to 100 year event and from fluvial<br>flooding to an even higher level | Cycle 2                    | BCR = 0.5                 |
| 3-FP               | flood proofing | flood proofing structures in flood plain<br>up to the 100 year flood elevation  | Cycle 2                    | technically<br>infeasible |
| 3-E                | evacuation     | evacuation of all structures in 100 year<br>flood plain   | Cycle 2                    | BCR < 1.0                 |

TABLE 6  
LOCAL ALTERNATIVE MEASURES  
DAMAGE CENTER 4  
CHRISTINA RIVER, CHRISTIANA ACRES

| <u>Alternative</u> | <u>Type</u>    | <u>Description</u>  | <u>When<br/>Eliminated</u> | <u>Why<br/>Eliminated</u>       |
|--------------------|----------------|---|----------------------------|---------------------------------|
| 4-L                | levee          | earth levee protecting from flooding up to 100 year event                   | Cycle 5                    | No local sponsor<br>(BCR = 1.4) |
| 4-FP               | flood proofing | flood proofing structures in flood plain up to the 100 year flood elevation | Cycle 2                    | technically infeasible          |
| 4-E                | evacuation     | purchase and removal of all homes in 100 year flood plain                   | Cycle 3                    | BCR = 0.4                       |

TABLE 7  
LOCAL ALTERNATIVE MEASURES  
DAMAGE CENTER 8  
CHRISTINA RIVER, DEL. RT. 896

| <u>Alternative</u> | <u>Type</u>       | <u>Description</u>  | <u>When<br/>Eliminated</u> | <u>Why<br/>Eliminated</u>    |
|--------------------|-------------------|---|----------------------------|------------------------------|
| 8-L                | levee             | earth levee protecting from flooding up to 100 year event   | Cycle 2                    | BCR = 0.2                    |
| 8-CM               | channel deepening | deepening the channel from the Dayett Mill dam upstream to the Chestnut Hill Road bridge (including removal of the dam) - | Cycle 5                    | no local sponsor (BCR = 0.8) |
| 8-E                | evacuation        | purchase and removal of buildings in 100 year flood plain   | Cycle 2                    | BCR = 0.1                    |
| 8-FP               | flood proofing    | flood proofing structures up to the 100 year flood elevation  | Cycle 2                    | technically infeasible       |

TABLE 8  
LOCAL ALTERNATIVE MEASURES  
DAMAGE CENTER 10  
CHRISTINA RIVER, NEWARK

| <u>Alternative</u> | <u>Type</u>                     | <u>Description</u>   | <u>When<br/>Eliminated</u> | <u>Why<br/>Eliminated</u> |
|--------------------|---------------------------------|--|----------------------------|---------------------------|
| 10-L               | levee                           | earth levee protecting from flooding up to the 100 year event  | Cycle 2                    | BCR = 0.5                 |
| 10-BM              | bridge modification             | modification of the Barksdale Road bridge - reduces flood stages   | Cycle 3                    | BCR = 0.4                 |
| 10-CM              | channel and bridge modification | bridge modification described for 10-BM in combination with deepening the Christina River from the Barksdale Road bridge upstream to the Church Road bridge - reduces flood stages | Cycle 2                    | BCR = 0.3                 |
| 10-E               | evacuation                      | purchase and removal of all homes which would be damaged by a 100 year flood   | Cycle 2                    | BCR = 0.3                 |
| 10-FP              | flood proofing                  | flood proofing homes up to the 100 year flood elevation  | Cycle 2                    | technically infeasible    |



TABLE 9  
LOCAL ALTERNATIVE MEASURES  
DAMAGE CENTER 13  
RED CLAY CREEK, STANTON

| <u>Alternative</u> | <u>Type</u>         | <u>Description</u>   | <u>When<br/>Eliminated</u> | <u>Why<br/>Eliminated</u> |
|--------------------|---------------------|--|----------------------------|---------------------------|
| 13-L               | levee               | earth levee protecting from flooding up to the 100 year event                | Cycle 2                    | BCR = 0.5                 |
| 13-BM              | bridge modification | modification of the Route 4 bridge - reduces flood stages upstream           | Cycle 2                    | BCR = 0.2                 |
| 13-FP              | flood proofing      | flood proofing homes up to the 100 year flood elevation                      | Cycle 2                    | technically infeasible    |
| 13-E               | evacuation          | purchase and removal of all homes which would be damaged by a 100 year flood | Cycle 2                    | BCR = 0.2                 |

NOTE: Alternative 20-CM and 20-BM1 on the White Clay Creek at Stanton would also effect damage center 13.  
See Table 13 for descriptions.

TABLE 10  
LOCAL ALTERNATIVE MEASURES  
DAMAGE CENTER 14  
RED CLAY CREEK, MARSHALLTON

| <u>Alternative</u> | <u>Type</u>         | <u>Description</u>   | <u>When<br/>Eliminated</u> | <u>Why<br/>Eliminated</u>       |
|--------------------|---------------------|--|----------------------------|---------------------------------|
| 14-L1              | levee/floodwall     | earth levees and concrete floodwalls protecting from flooding up to the 100 year event   | Cycle 5                    | no local sponsor<br>(BCR = 1.3) |
| 14-L2              | levee/floodwall     | earth levees and concrete floodwalls protecting from flooding up to the Standard Project Flood   | Cycle 3                    | incremental<br>BCR < 1.0        |
| 14-BM1             | bridge modification | modification of the Kiamansi Road bridge - reduces flood stages upstream   | Cycle 2                    | BCR = 0.4                       |
| 14-BM2             | bridge modification | modifications of the Route 4 and Kiamansi Road bridges (a combination of alternatives 13-BM and 14-BM1)  | Cycle 2                    | BCR = 0.2                       |
| 14-CM              | channel deepening   | deepening the channel of Red Clay Creek from the Kiamansi Road bridge upstream to Del. Rt. 41 including removal of 2 masonry dams and lining the channel with concrete | Cycle 2                    | BCR = 0.4                       |
| 14-FP              | flood proofing      | flood proofing buildings up to the 100 year flood elevation  | Cycle 5                    | no local sponsor<br>(BCR = 7.9) |
| 14-E               | evacuation          | purchase and removal of several commercial and industrial structures on the stream bank  | Cycle 2                    | BCR = 0.6                       |

TABLE 11  
LOCAL ALTERNATIVE MEASURES  
DAMAGE CENTER 16  
RED CLAY CREEK, WOODDALE

| <u>Alternative</u> | <u>Type</u>       | <u>Description</u>  | <u>When<br/>Eliminated</u> | <u>Why<br/>Eliminated</u>       |
|--------------------|-------------------|---|----------------------------|---------------------------------|
| 16-L               | levee             | earth levee protecting from flooding up to the 100 year event | Cycle 2                    | BCR = 0.4                       |
| 16-CM              | channel deepening | deepening the channel of Red Clay Creek                       | Cycle 2                    | BCR < 1.0                       |
| 16-FP              | flood proofing    | flood proofing buildings up to the 100 year flood elevation   | Cycle 5                    | no local sponsor<br>(BCR = 1.0) |
| 16-E               | evacuation        | evacuation of all structures in 100 year flood plain          | Cycle 2                    | BCR < 1.0                       |

TABLE 12  
LOCAL ALTERNATIVE MEASURES  
DAMAGE CENTER 17  
RED CLAY CREEK, YORKLYN

| <u>Alternative</u> | <u>Type</u>          | <u>Description</u>  | <u>When<br/>Eliminated</u> | <u>Why<br/>Eliminated</u>       |
|--------------------|----------------------|---|----------------------------|---------------------------------|
| 17-L               | levee/floodwall      | earth levees and concrete floodwalls protecting from flooding up to the 100 year event                            | Cycle 2                    | BCR = 0.3                       |
| 17-BM              | bridge modification  | modification of the Yorklyn Road bridge was considered  | Cycle 2                    | BCR < 1.0                       |
| 17-BC              | bypass channel       | new channel through Yorklyn would be straighter, deeper, and further from buildings than existing Red Clay Creek  | Cycle 2                    | BCR = 0.5                       |
| 17-CM              | channel modification | removal of the dam below Yorklyn Road bridge was considered   | Cycle 2                    | BCR < 1.0                       |
| 17-FP              | flood proofing       | flood proofing buildings in Yorklyn up to the 100 year flood elevation  | Cycle 5                    | no local sponsor<br>(BCR = 0.7) |
| 17-E               | evacuation           | purchase and removal of commercial and industrial buildings in Yorklyn which would be damaged by a 100 year flood | Cycle 2                    | BCR < 0.1                       |

TABLE 13  
LOCAL ALTERNATIVE MEASURES  
DAMAGE CENTER 20  
WHITE CLAY CREEK, STANTON

| <u>Alternative</u> | <u>Type</u>          | <u>Description</u>  | <u>When<br/>Eliminated</u> | <u>Why<br/>Eliminated</u>       |
|--------------------|----------------------|---|----------------------------|---------------------------------|
| 20-L1              | levee/floodwall      | earth levees and concrete floodwalls protecting from flooding up to the 100 year event  | Cycle 3                    | incremental<br>BCR < 1.0        |
| 20-L2              | levee/floodwall      | earth levees and concrete floodwalls protecting from flooding up to the SPF   | Cycle 5                    | no local sponsor<br>(BCR = 1.4) |
| 20-CM              | channel modification | excavation of accumulated sediment from a 600 ft. length of the stream centering on the Penn Central Railroad bridge - reduces stages | Cycle 5                    | no local sponsor<br>(BCR = 2.4) |
| 20 BM1             | bridge modification  | modification of the Penn Central Railroad bridge was considered   | Cycle 2                    | BCR < 1.0                       |
| 20-BM2             | bridge modification  | modification of the Route 7 bridge would lower stream stages  | Cycle 2                    | BCR = 0.1                       |
| 20-FP              | flood proofing       | flood proofing buildings in the flood plain up to the 100 year flood elevation  | Cycle 5                    | no local sponsor<br>(BCR = 6.7) |
| 20-E               | evacuation           | purchase and removal of several commercial and industrial buildings   | Cycle 3                    | BCR = 0.5                       |

TABLE 14  
LOCAL ALTERNATIVE MEASURES  
DAMAGE CENTER 21  
WHITE CLAY CREEK, HARMONY HILLS

| <u>Alternative</u> | <u>Type</u>    | <u>Description</u>  | <u>When<br/>Eliminated</u> | <u>Why<br/>Eliminated</u> |
|--------------------|----------------|---|----------------------------|---------------------------|
| 21-L               | levee          | earth levee protecting homes from flooding<br>up to the 100 year event            | Cycle 2                    | BCR = 0.2                 |
| 21-FP              | flood proofing | flood proofing homes in the flood plain<br>up to the 100 year flood elevation     | Cycle 2                    | technically<br>infeasible |
| 21-E               | evacuation     | purchase and removal of all homes which<br>would be damaged by the 100 year flood | Cycle 2                    | BCR = 0.2                 |

TABLE 15  
LOCAL ALTERNATIVE MEASURES  
DAMAGE CENTER 22  
WHITE CLAY CREEK, NEWARK

| <u>Alternative</u> | <u>Type</u>                      | <u>Description</u>   | <u>When<br/>Eliminated</u> | <u>Why<br/>Eliminated</u> |
|--------------------|----------------------------------|--|----------------------------|---------------------------|
| 22-L               | floodwalls                       | concrete floodwalls protecting industries from flooding up to the 100 year event   | Cycle 2                    | BCR = 0.4                 |
| 22-BM              | bridge modification              | modification of the Chappel Street bridge would lower stream stages upstream   | Cycle 2                    | BCR = 0.2                 |
| 22-CM1             | bridge and channel modifications | bridge modification described for 22-BM in combination with removal of the dam above Chappel Street                            | Cycle 2                    | BCR = 0.3                 |
| 22-CM2             | channel modification             | removal of the dam above Chappel Street, lining the channel with concrete for 3,500 ft. downstream, and improving the overbank | Cycle 2                    | BCR = 0.6                 |
| 22-FP              | flood proofing                   | flood proofing industrial buildings along the stream bank up to the 100 year flood elevation                                   | Cycle 2                    | technically infeasible    |
| 22-E               | evacuation                       | purchase and removal of several industrial buildings which would be damaged by the 100 year flood                              | Cycle 2                    | BCR = 0.3                 |

TABLE 16  
LOCAL ALTERNATIVE MEASURES  
DAMAGE CENTER 27  
LITTLE MILL CREEK, BRACK-EX, ELSMERE, GREENVILLE

| <u>Alternative</u>                            | <u>Type</u>   | <u>Description</u>   | <u>Why<br/>Eliminated</u>       |
|---|---|--|---------------------------------|
| Recommended<br>Plan (June 1960<br>Resolution) | detention basin,<br>channel improvements,<br>bridge modifications | detention basin on the Ferris Industrial<br>School grounds; channel improvement on<br>Derrickson Run and Little Mill Creek;<br>stream clearance on Chestnut Run; and<br>modifications of the bridge openings at<br>Richards Avenue on Derrickson Run and<br>the bridge under the B&O Railroad<br>Wilsmere yards. | no local sponsor<br>(BCR = 1.8) |



TABLE 17  
REGIONAL ALTERNATIVE MEASURES  
CHRISTINA RIVER BASIN

| <u>Alternative</u>                   | <u>Type</u>              | <u>Description 1/</u>  | <u>When<br/>Eliminated</u> | <u>Why<br/>Eliminated</u> |
|--------------------------------------|--------------------------|--|----------------------------|---------------------------|
| R-1A                                 | dry reservoir            | dam on Brandywine Creek  | Cycle 2                    | BCR < 0.3                 |
| R-1B                                 | permanent pool reservoir | dam on Brandywine Creek  | Cycle 2                    | BCR < 1.0                 |
| R-2A                                 | dry reservoir            | dam on Brandywine Creek  | Cycle 2                    | BCR < 0.5                 |
| R-2B                                 | permanent pool reservoir | dam on Brandywine Creek  | Cycle 2                    | BCR < 1.0                 |
| R-4, R-5<br>R-9, R-10A               | dry reservoirs           | series of small dams along Red<br>Clay Creek and its tributaries | Cycle 2                    | BCR < 0.8                 |
| R-3, R-4,<br>R-6, R-7,<br>R-9, R-10A | dry reservoirs           | series of small dams along Red<br>Clay Creek and its tributaries | Cycle 2                    | BCR < 0.4                 |
| R-8                                  | permanent pool reservoir | dam on Red Clay Creek  | Cycle 2                    | BCR < 1.4                 |
| R-10B                                | permanent pool reservoir | dam on Red Clay Creek  | Cycle 5                    | no local sponsor          |
| R-11A                                | dry reservoir            | dam on White Clay Creek  | Cycle 2                    | BCR < 0.5                 |
| R-11B                                | permanent pool reservoir | dam on White Clay Creek  | Cycle 5                    | no local sponsor          |
| R-12A                                | dry reservoir            | dam on East Branch Brandywine Creek                              | Cycle 3                    | BCR = 0.5                 |

1/ Locations of reservoir sites shown on Plate 4.

TABLE 17 (Continued)

| <u>Alternative</u> | <u>Type</u>  | <u>Description</u>  | <u>When<br/>Eliminated</u> | <u>Why<br/>Eliminated</u>                 |
|--------------------|--|---|----------------------------|---|
| FW-1               | flood forecasting, flood warnings, preparedness planning | basin-wide plan to reduce flood damage and loss of life   | Cycle 5                    | requires local implementation (BCR = 6.3) |
| T-1                | tide gate  | tide gate, levee, and floodwall system to protect against high tides                              | Cycle 2                    | BCR < 0.2                                 |
| T-2                | tide gate  | tide gate, levee, and floodwall system to protect against high tides                              | Cycle 2                    | BCR < 0.5                                 |
| FI-1               | flood insurance  | basin-wide plan to increase participation and coverage under the National flood Insurance Program | Cycle 5                    | no local sponsor (BCR = 1.0)              |
| SW-1               | storm water management                                   | basin-wide plan to control future increases in flood flows through use of various measures        | Cycle 5                    | requires local implementation             |
| FZ-1               | flood plain zoning                                       | basin-wide plan to regulate the use of flood plains   | Cycle 5                    | requires local implementation             |

Plan FZ-1 would provide for flood plain zoning beyond that required by the Federal Insurance Administration and by existing county ordinances. It is becoming apparent nationally that 100 year flood protection should not automatically be the upper limit of flood control planning and management. Whether greater flood plain criteria should be pursued depends on the nature of flooding and the type and density of flood plain development. While flood plain management is oriented towards overall basin planning, flood plain zoning matters are considered on a damage center basis. Flood zoning is considered as a supplementary alternative flood control plan because it does not eliminate existing flooding. However, it could be effective in limiting future increases in flood damages and even reducing flood damages in the future.

#### ASSESSMENT AND EVALUATION OF DETAILED PLANS

As a result of the preliminary planning accomplished in Stage 2, only one plan was found which needed to be assessed and evaluated further in Stage 3. This section describes Plan 1A-L2 and presents the results of the Stage 3 studies.

#### DESCRIPTION OF PLAN 1A-L2

As formulated in Stage 2, this plan would protect part of Wilmington, Delaware, from up to a standard project flood by providing a levee along both sides of the Christina River. The Delaware River levee would be an earth structure with armor stone protection against wave action. Its length would be 2,150 feet along the Delaware River south of the confluence with the Christina River and would have a top elevation of 22 feet MSLD 1/. A 20,900 foot long levee and floodwall would be provided along the south side of the Christina River and a 10,000 foot long levee and floodwall would be

1/ mean sea level datum

provided along the north side. The earth levees and concrete floodwalls would be up to 11 feet above the River bank and have top elevations of 17 feet MSLD. Closures would be provided in the levee/floodwall system for road and railroad access. Interior drainage would be provided by several pumping stations along the levees and floodwalls.

During Stage 3 planning, the plan was modified for incremental justification. It was found that the levees and floodwalls along the north side of the Christina River were marginally unjustified and that construction of levees and floodwalls along the south bank only would not have any adverse effect on the north bank due to the tidal nature of the flooding. The portion of plan 1A-L2 along the north bank of the river was therefore eliminated. Plate 5 shows the revised plan.

A detailed study was conducted for interior drainage behind the remaining portion of the plan, the levees and floodwalls along the Delaware River and the south bank of the Christina River. The resulting interior drainage plan consists of 10 gated 48 inch diameter gravity outfalls and 3 small pump stations totaling 50 cfs in capacity. All existing storm sewer lines and drainage ditches would be connected to this system.

The 18,100 feet of levee would be constructed of earth taken from the nearby Wilmington Harbor dredging spoil disposal area. This material was tested and found to be suitable for levee construction. The levee along the Delaware River would be constructed to elevation 22 feet MSLD to allow for settlement (3 feet) and freeboard and wave runup (5 feet above the design tide elevation (SPF)). Levees along the Christina River would be constructed to elevation 17 feet MSLD to provide three feet of freeboard over the standard project hurricane tide elevation.

Reinforced concrete floodwalls would be provided in areas where levee construction would be impractical due to space limitations. These floodwalls would have to be pile supported due to the poor subsurface

conditions in the area. The top elevation would be at elevation 17 feet MSLD. Three feet of freeboard would be included. The total length of floodwall would be about 4,900 feet.

#### ASSESSMENT AND EVALUATION OF PLAN 1A-L2

The effects of plan 1A-L2 on national economic development, environmental quality, regional development, and social well-being are summarized on Table 18. As is shown on Table 19, the first cost of this project would be approximately \$12,895,000 based on October 1980 price levels, and would require annual operation and maintenance of approximately \$67,000 per year. It would provide NED benefits of \$1,543,000 for reduced flood damage. Residual flood damages in the protected area would be approximately \$27,000 on an average annual basis due to interior ponding. All damage due to tidal and fluvial flooding except for very rare events would be eliminated. Flood stages and damages on the unprotected north bank of the Christina River opposite this project would not be adversely affected. The NED benefit to cost ratio is 1.5 based on a 100 year economic life and a 7-3/8 percent discount rate.

In September 1980 the City of Wilmington, local sponsor for Plan 1A-L2, was provided with the latest information on the plan and the cost-sharing requirements and was asked whether it was still willing and able to act as non-federal sponsor and provide the required items of local cooperation. The City responded by letter dated 28 January 1981 that they were withdrawing their sponsorship due to the magnitude of the local share of the cost and their commitment to reduce the City's outstanding debt. Since both New Castle County and the State of Delaware declined to sponsor structural flood control projects in Wilmington during previous coordination, this leaves Plan 1A-L2 without a non-federal sponsor and render it unimplementable. Pertinent correspondence from the City of Wilmington, New Castle County, and the State of Delaware is included in Appendix 1.

TABLE 18

EFFECTS ASSESSMENTS  
PLAN 1A-1.2

(South side of Christina River only)

| NATIONAL ECONOMIC DEVELOPMENT |  | REGIONAL DEVELOPMENT   |  |
|-------------------------------|--|------------------------|--|
| A. BENEFITS:                  | Tidal Fluvial Urbanization and Residential Affluence   | \$ 1,495,000<br>38,000 |  |
|                               | Total Annual   | <u>10,000</u>          |  |
|                               |  | \$ 1,543,000           |  |
| B. COSTS:                     | Initial Cost   | \$12,895,000           |  |
|                               | Amortization & Interest  | 951,800                |  |
|                               | Annual O&M Cost  | 67,000                 |  |
| C. BENEFIT/COST RATIO:        | Residual Interior Damage (Ave. Annual)   | 27,000                 |  |
|                               | Total Annual   | \$ 1,045,800           |  |
|                               | Tidal and Fluvial (Existing) Including Urbanization & Affluence  | 1.5                    |  |
| ENVIRONMENTAL QUALITY         |  | 1.5                    |  |
| A. TEMPORARY EFFECTS          | 1. Short Term Effect on Aquatic Life During Construction Activities  |                        |  |
|                               | 2. Temporary Water Quality Degradation During Construction Activities  |                        |  |
|                               | 3. Temporary Adverse, Localized Degradation of Air Quality During Construction Activities                            |                        |  |
| B. PERMANENT EFFECTS          | 1. Loss of Wetland Habitat in Vicinity of Levees   |                        |  |
|                               |  |                        |  |
|                               |  |                        |  |
| A. TEMPORARY EFFECTS          | 1. Temporary Increase in Employment During Project Construction  |                        |  |
|                               |  |                        |  |
|                               |  |                        |  |
| B. PERMANENT EFFECTS          | 1. A non-Federal First Cost of \$3.9 Million and Annual O&M Costs of \$67,000 (based on current cost-sharing policy) |                        |  |
|                               | 2. Increase in Output of Goods and Service in Protected Area   |                        |  |
|                               | 3. Increased Employment Opportunities  |                        |  |
| C. BENEFIT/COST RATIO:        | 4. Increased Potential for Industrial Development in Protected Area  |                        |  |
|                               | 5. Flood Insurance Will Not Be Required in Protected Area  |                        |  |
|                               |  |                        |  |
| SOCIAL WELL-BEING             |  |                        |  |
| A. TEMPORARY EFFECTS          | 1. Temporary Loss of Transportation and Utility Services During Construction Activities                              |                        |  |
|                               |  |                        |  |
|                               |  |                        |  |
| B. PERMANENT EFFECTS          | 1. No Permanent Adverse Effects on Recreational Facilities   |                        |  |
|                               | 2. Provision of Protection From Tidal Flooding for All Storm Frequencies Up Through the Standard Project Flood       |                        |  |
|                               | 3. General Well Being of Protected Businesses and Residents Will Improve   |                        |  |
| C. BENEFIT/COST RATIO:        | 4. Reduction or Elimination of Emergency Loss or Disruption of Public Facilities                                     |                        |  |
|                               |  |                        |  |
|                               |  |                        |  |

TABLE 19

COST ESTIMATE  
PLAN 1A-L2

(South Side of Christina River Only)

| ITEM                                       | UNIT | QUANTITY | UNIT COST | COST        |
|--|------|----------|-----------|-------------|
| <b>DELAWARE RIVER LEVEE</b>                |      |          |           |             |
| Earth Excavation & Disposal                | CY   | 6,985    | \$ 2.50   | \$ 17,500   |
| Compacted Fill                             | CY   | 60,891   | 3.10      | 188,800     |
| Bedding (12 in.)                           | CY   | 3,074    | 34.00     | 104,500     |
| Riprap (2 ft.)                             | CY   | 6,148    | 45.00     | 276,700     |
| Seed & Mulch                               | SY   | 16,882   | 0.40      | 6,800       |
| Railroad Closure Structure                 | EA   | 1        | 35,800.   | 35,800      |
| Delaware River Subtotal                    |      |          |           | \$ 630,100  |
| <b>CHRISTINA RIVER SOUTH</b>               |      |          |           |             |
| <b>Floodwalls</b>                          |      |          |           |             |
| Earth Excavation                           | CY   | 12,679   | \$ 3.90   | 49,500      |
| Reinforced Concrete                        | CY   | 9,000    | 225.00    | 2,025,000   |
| H-Piles                                    | LF   | 105,570  | 13.40     | 1,414,600   |
| Pipe Piles                                 | LF   | 24,570   | 14.60     | 358,700     |
| Sheet Pile Cut-off                         | SF   | 27,300   | 9.00      | 245,700     |
| Backfill, Disposal of Balance              | CY   | 7,073    | 3.35      | 23,700      |
| <b>Levees</b>                              |      |          |           |             |
| Earth Excavation                           | CY   | 17,218   | 2.50      | 43,000      |
| Compacted Fill                             | CY   | 309,368  | 3.10      | 959,000     |
| Seed & Mulch                               | SY   | 104,622  | 0.40      | 41,900      |
| Closure Structures                         | SF   | 3,141    | 110.00    | 345,500     |
| Floodwall & Levee Subtotal                 |      |          |           | \$5,506,600 |
| <b>INTERIOR DRAINAGE</b>                   |      |          |           |             |
| <b>Pumping Station</b>                     |      |          |           |             |
| 1. Q = 19 cfs                              | LS   |          |           | 131,600     |
| 2. Q = 25 cfs                              | LS   |          |           | 172,500     |
| 3. Q = 6 cfs                               | LS   |          |           | 61,000      |
| 48" O outfall structures (levee)           | EA   | 8        | 39,300.   | 314,400     |
| 48" O outfall structures (flood-wall)      | EA   | 2        | 30,500.   | 61,000      |
| Excavation (Ditch)                         | CY   | 14,000   | 5.00      | 70,000      |
| Manholes                                   | EA   | 4        | 2,000.    | 8,000       |
| Inlets                                     | EA   | 25       | 1,500.    | 37,500      |
| Utility Relocations                        | LS   |          | 150,000.  | 150,000     |
| Maint. Traffic RR & RD Crossings & Repairs | LS   |          | 200,000.  | 200,000     |
| 12" R.C. Pipe                              | LF   | 300      | 7.00      | 2,100       |
| 36" R.C. Pipe                              | LF   | 6,700    | 36.00     | 241,200     |
| 48" R.C. Pipe                              | LF   | 3,300    | 49.00     | 161,700     |
| 54" R.C. Pipe                              | LF   | 1,300    | 66.00     | 85,800      |
| 60" R.C. Pipe                              | LF   | 300      | 83.00     | 24,900      |
| Interior Drainage Subtotal                 |      |          |           | \$1,721,700 |

TABLE 19 (Cont'd)

| <u>ITEM</u>                 | <u>UNIT</u> | <u>QUANTITY</u> | <u>UNIT COST</u> | <u>COST</u>      |
|-----------------------------|-------------|-----------------|------------------|------------------|
| CONTINGENCIES @ 20%         |             |                 | subtotal         | \$ 7,858,400     |
| SUBTOTAL                    |             |                 |                  | <u>1,571,700</u> |
|                             |             |                 |                  | \$ 9,430,100     |
| REAL ESTATE                 |             |                 |                  |                  |
| Frontage for Levees & Walls | AC          | 38              | \$25,00          | 950,000          |
| Contingencies @ 20%         | LS          |                 |                  | <u>190,000</u>   |
| SUBTOTAL                    |             |                 |                  | \$10,570,000     |
| E&D @ 13%                   |             |                 |                  | 1,374,100        |
| S&A @ 9%                    |             |                 |                  | <u>951,300</u>   |
| TOTAL FIRST COST            |             |                 |                  | \$12,895,400     |



## AGENCY AND PUBLIC COORDINATION

The draft report on the findings of the investigation was distributed to interested agencies and public officials. Letters containing comments in response to circulation of the draft report are included in the correspondence appendix. Some comments indicated that affected communities will make use of the technical data generated during this study. Regret was expressed that no favorable projects could be recommended; however, there appears to be general acceptance regarding the findings from the study. Sometime in the future, New Castle County Department of Planning and the State of Delaware Department of Natural Resources and Environmental Control may examine further the possibility of channel modification project for White Clay and Little Mill Creeks in new Castle County under the small continuing authorities program. The National Weather Service indicated that because of the high BCR of plan FW-1, they will further investigate the feasibility of developing and implementing a local self-help flood forecast and warning system.

## CONCLUSIONS

The Christina River Basin Study identified 32 damage centers of which 14 were designated as major. More than 80 alternative flood control plans were investigated, including both structural and non-structural measures.

All plans have been eliminated for one or more of the following reasons: lack of economic justification, opposition by local officials and the public, inability of the potential local sponsor to provide financial support, and implementation clearly not a Corps responsibility.

Consequently, further consideration of flooding and related problems in the Christina River Basin is not warranted under this authority.

It should be noted, however, that as a result of this study the National Weather Service will further investigate community interest in developing and implementing a local self-help forecast and warning program with the local communities and counties involved. The NWS Self-Help Community Flood Forecast and Warning Program has a wide range of options from a manual volunteer rainfall network and forecast system to a computer-based observational forecast and warning system. When combined with a community preparedness program and an interested and cooperative citizenry, NWS indicates that flood damages may be reduced by as much as 30 percent.

RECOMMENDATIONS

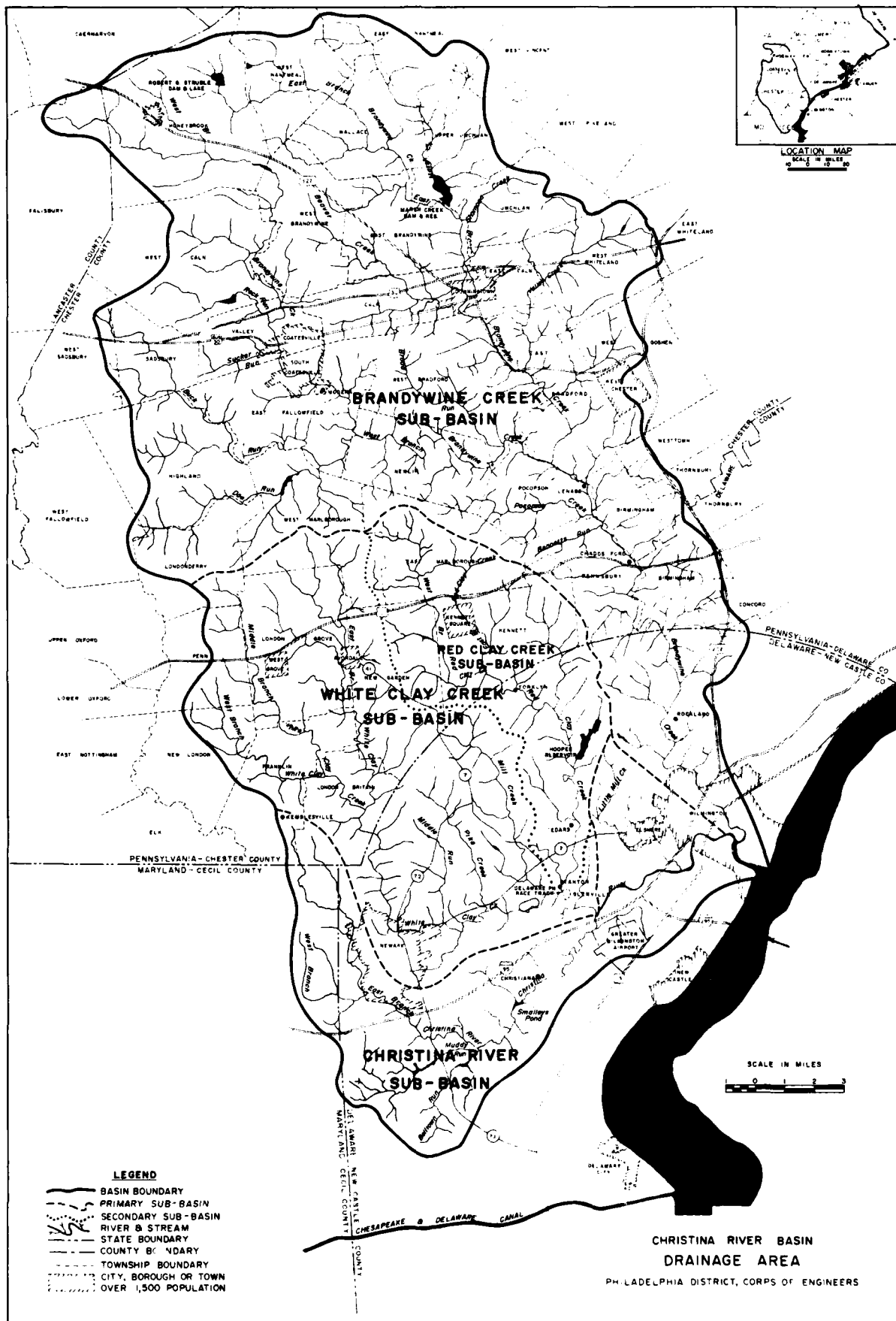
I recommend that no improvements for flood control in the Christina River Basin be authorized by the United States at this time.

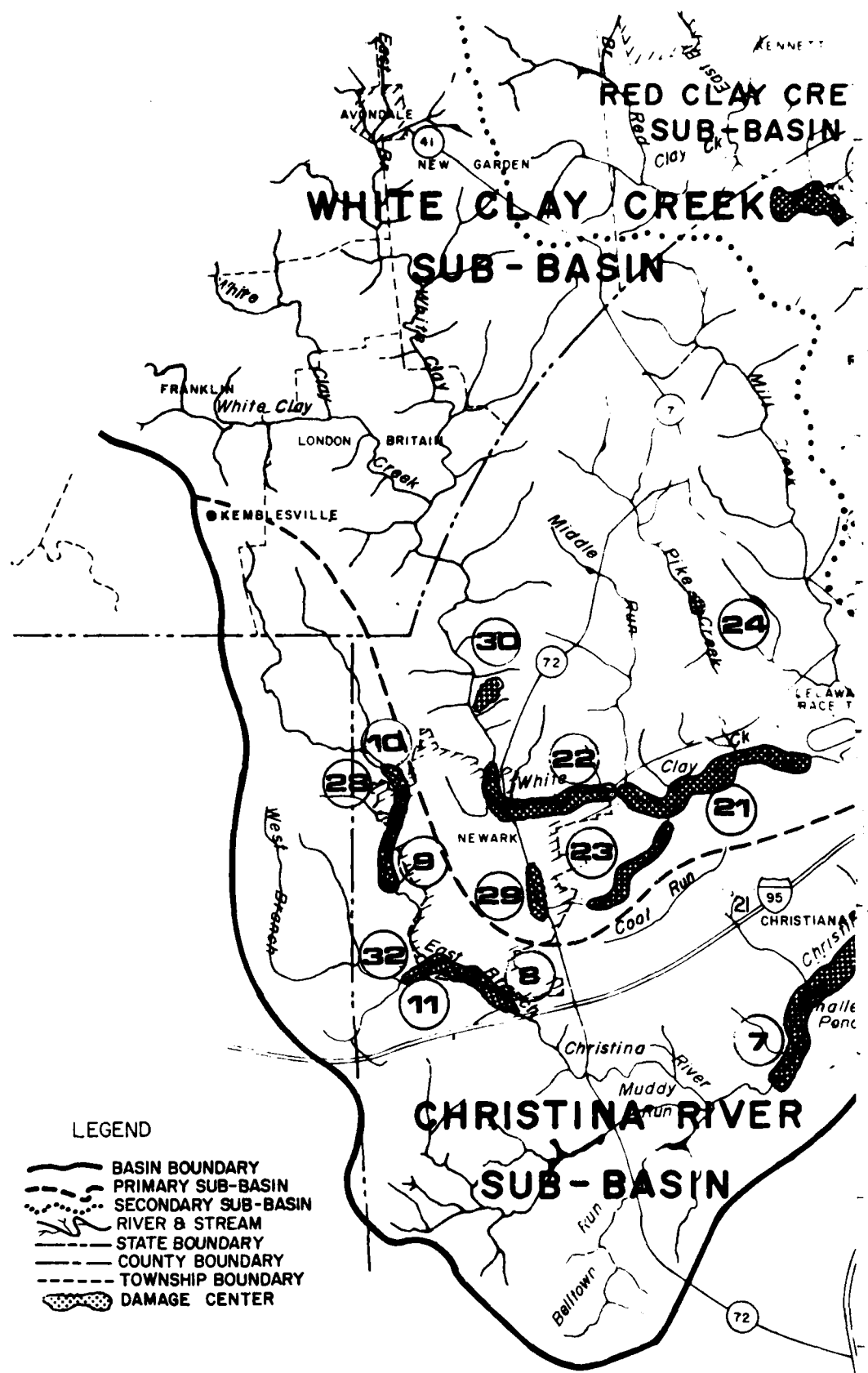
A handwritten signature in dark ink, appearing to read "Roger Baldwin". The signature is written in a cursive style with a large, prominent "R" and "B".

ROGER L. BALDWIN

Lieutenant Colonel, Corps of Engineers  
Commanding

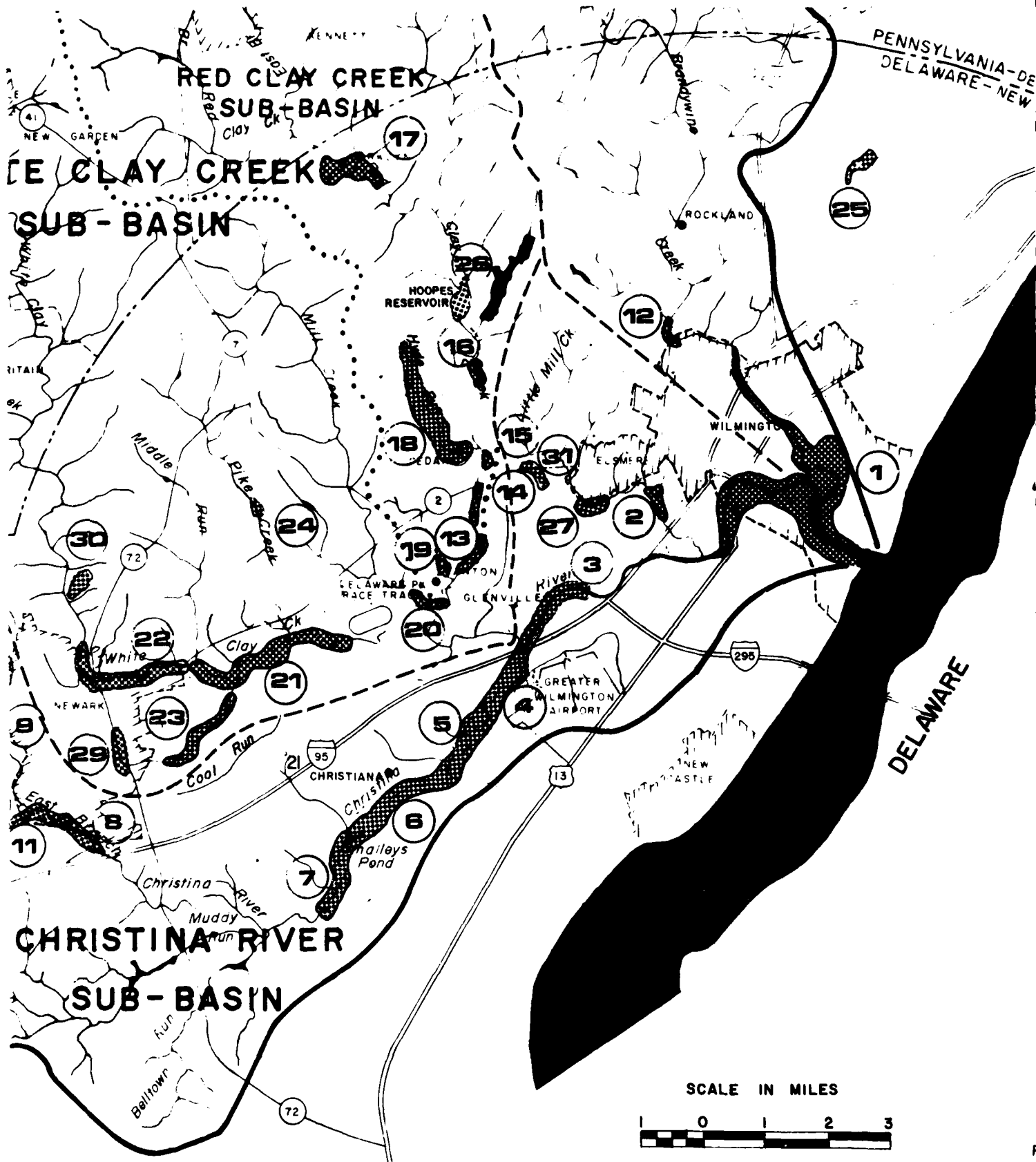


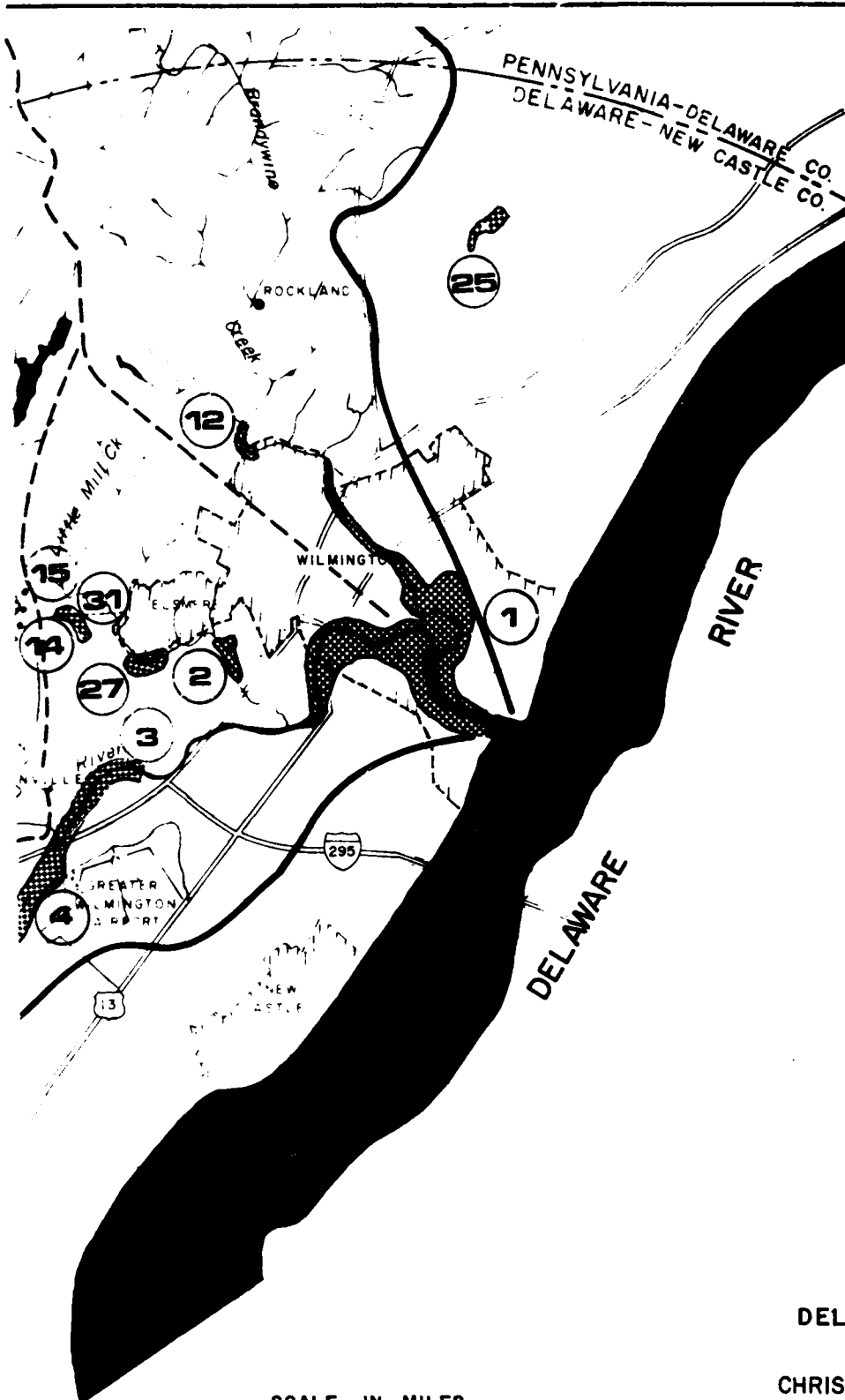




# LEGEND

- BASIN BOUNDARY
- PRIMARY SUB-BASIN
- SECONDARY SUB-BASIN
- RIVER & STREAM
- STATE BOUNDARY
- COUNTY BOUNDARY
- TOWNSHIP BOUNDARY
- DAMAGE CENTER





DELAWARE PORTION

CHRISTINA RIVER BASIN

DAMAGE CENTERS

PHILADELPHIA DISTRICT, CORPS OF ENGINEERS



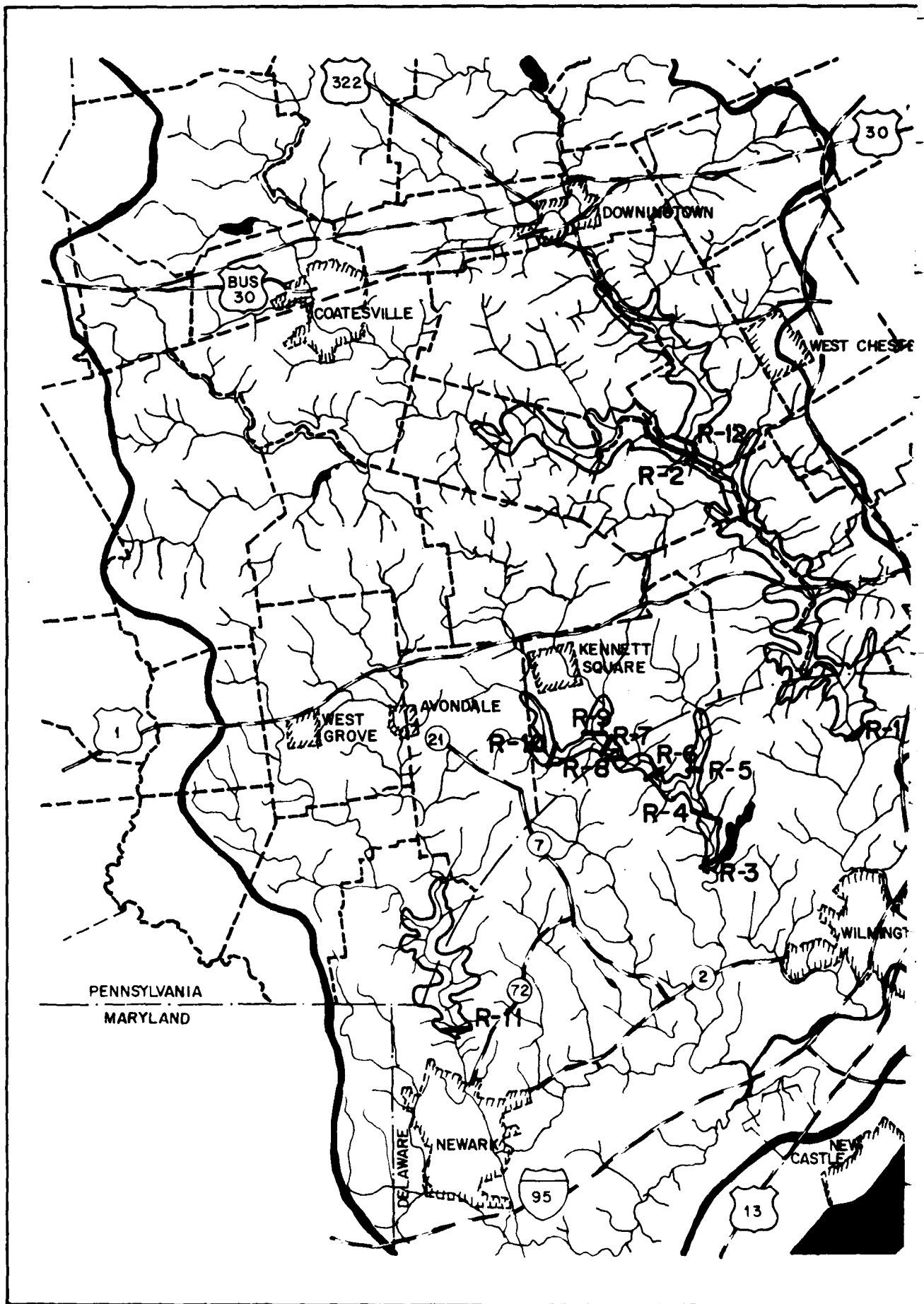
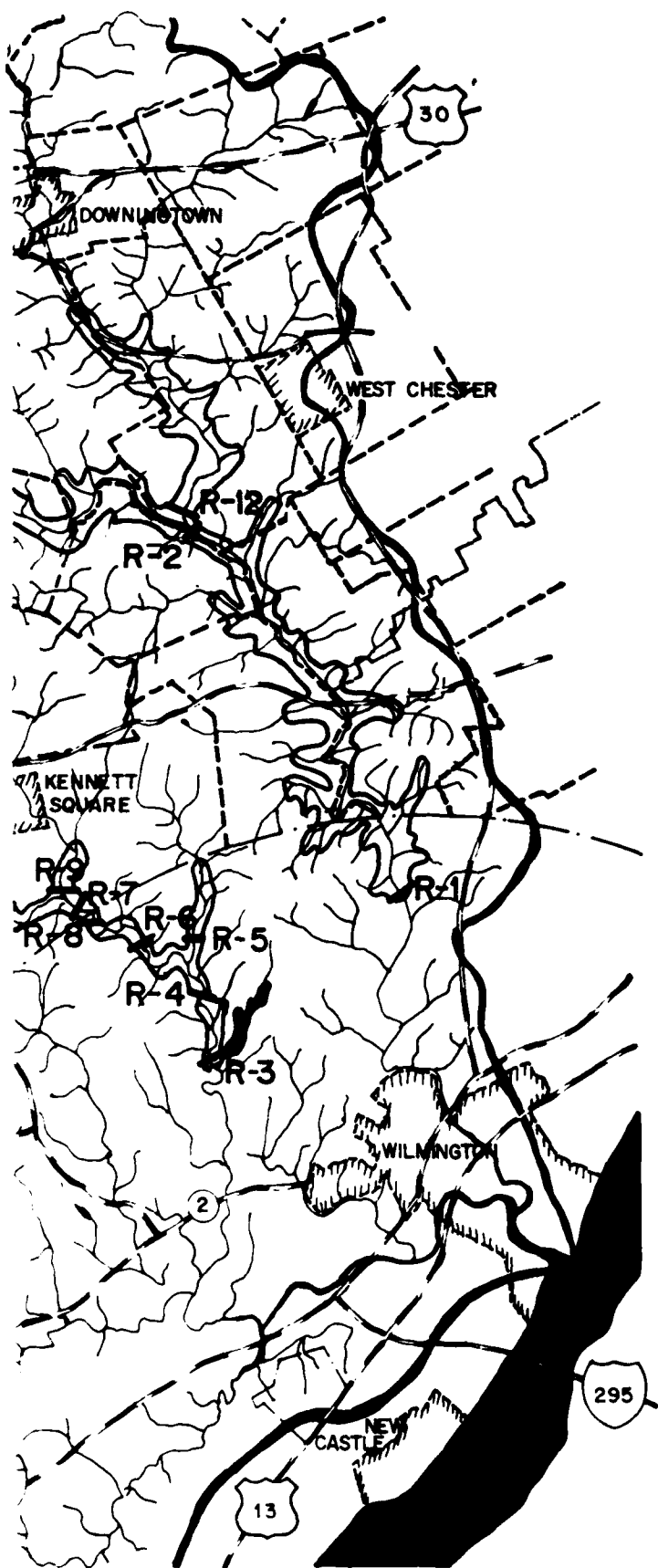


PLATE 4



DAM AND RESERVOIR ALTERNAT

| RESERVOIR<br>NUMBER | LOCATION            | TYPE                         |
|---------------------|---------------------|------------------------------|
| 1                   | BRANDYWINE<br>CREEK | MULTIPURPOSE<br>DRY DAM SITE |
| 2                   | BRANDYWINE<br>CREEK | MULTIPURPOSE<br>DRY DAM SITE |
| 3                   | RED CLAY<br>CREEK   | DRY DAM SITE                 |
| 4                   | RED CLAY<br>CREEK   | DRY DAM SITE                 |
| 5                   | RED CLAY<br>CREEK   | DRY DAM SITE                 |
| 6                   | RED CLAY<br>CREEK   | DRY DAM SITE                 |
| 7                   | RED CLAY<br>CREEK   | DRY DAM SITE                 |
| 8                   | RED CLAY<br>CREEK   | MULTIPURPOSE<br>DAM SITE     |
| 9                   | RED CLAY<br>CREEK   | DRY DAM SITE                 |
| 10                  | RED CLAY<br>CREEK   | MULTIPURPOSE<br>DRY DAM SITE |
| 11                  | WHITE CLAY<br>CREEK | MULTIPURPOSE<br>DRY DAM SITE |
| 12                  | BRANDYWINE<br>CREEK | DRY DAM SITE                 |

C  
DAM AI  
PHILADELPH

# DAM AND RESERVOIR ALTERNATIVES

| RESERVOIR<br>NUMBER | LOCATION            | TYPE                             |
|---------------------|---------------------|----------------------------------|
| 1                   | BRANDYWINE<br>CREEK | MULTIPURPOSE AND<br>DRY DAM SITE |
| 2                   | BRANDYWINE<br>CREEK | MULTIPURPOSE AND<br>DRY DAM SITE |
| 3                   | RED CLAY<br>CREEK   | DRY DAM SITE                     |
| 4                   | RED CLAY<br>CREEK   | DRY DAM SITE                     |
| 5                   | RED CLAY<br>CREEK   | DRY DAM SITE                     |
| 6                   | RED CLAY<br>CREEK   | DRY DAM SITE                     |
| 7                   | RED CLAY<br>CREEK   | DRY DAM SITE                     |
| 8                   | RED CLAY<br>CREEK   | MULTIPURPOSE<br>DAM SITE         |
| 9                   | RED CLAY<br>CREEK   | DRY DAM SITE                     |
| 10                  | RED CLAY<br>CREEK   | MULTIPURPOSE AND<br>DRY DAM SITE |
| 11                  | WHITE CLAY<br>CREEK | MULTIPURPOSE AND<br>DRY DAM SITE |
| 12                  | BRANDYWINE<br>CREEK | DRY DAM SITE                     |

CHRISTINA RIVER BASIN

DAM AND RESERVOIR LOCATIONS

PHILADELPHIA DISTRICT, CORPS OF ENGINEERS



APPENDIX 1

PERTINENT  
CORRESPONDENCE

## APPENDIX 1

### PERTINENT CORRESPONDENCE

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Appendix 1

COMMITTEE ON PUBLIC WORKS  
HOUSE OF REPRESENTATIVES, U. S.  
WASHINGTON, D. C.

RESOLUTION

Resolved by the Committee on Public Works of the House of Representatives, United States, That the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the reports of the Chief of Engineers on the Delaware River, New York, New Jersey and Pennsylvania, published as House Document Numbered 179, Seventy-third Congress, Second session, with a view to determining whether the recommendations contained therein should be modified in any way at the present time, with particular reference to the provision of flood-control improvements on Little Mill Creek, a tributary of Christina River in New Castle County, Delaware.

Adopted JUN 9 1930

Attest: \_\_\_\_\_

*Margaret R. Butler*

Clerk.

Appendix 1

(Requested by Rep. Harris E. McDevall, Jr.)

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permit fully legible reproduction



800-0000

Session

## United States Senate

COMMITTEE ON PUBLIC WORKS

### COMMITTEE RESOLUTION

RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE,

That the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby, requested to review the report of the Chief of Engineers on the Delaware River Basin published as House Document Numbered 523, Eighty-seventh Congress, and other pertinent reports, with a view to determining whether any improvements in the interest of flood control of both an urban and rural nature, navigation, water supply, wastewater management, recreation, and other allied purposes, with due consideration to preserving and enhancing environmental values, are advisable at the present time in the Christina River Basin.

Adopted: May 25, 1972  
S. 100-10000

*Jennings Randolph*  
Jennings Randolph, Chairman.

(At the request of Senator J. Caleb Boggs of Delaware)

Appendix 1

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DEPARTMENT OF THE ARMY  
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS  
CUSTOM HOUSE-2 D & CHESTNUT STREETS  
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-R

\*\*\*\*\*  
\*COPY\*  
\*\*\*\*\*

24 January 1974

Mr. Vernon M. Beard, Director  
Bureau of Resources Programming  
Department of Environmental Resources  
P. O. Box 1467  
Harrisburg, Pa. 17120

Dear Mr. Beard:

This is in reference to your letter of 3 December 1973 and to the Philadelphia District's Urban Study of the Christina River Basin and the direction in which that study is heading. This Urban Study effort seeks to provide a range of implementable urban water resources plans which result from an integrated approach to a specific basin's problems and needs. It has always been our goal, and we have stated such at many of our meetings, that extensive use be made of past and ongoing water resources planning efforts. We are very much aware of the extensive work done by the Commonwealth of Pennsylvania in the State Water Plan and that planned for in the State's Comprehensive Water Quality Management Plan. In fact we have been functioning on the basic premise that final study conclusions would not just be based on the actual investigations undertaken as the result of our Congressional authorization, but would utilize the investigations and reports conducted by other agencies. The Commonwealth's efforts would be prime examples of such other agency efforts in the basin. In fact it is our hope that our findings would add support to such efforts and their conclusions.

Let me assure you that the Corps of Engineers does not wish to supplant the Commonwealth of Pennsylvania in its leadership role in the comprehensive planning for the people of Pennsylvania. Nor do we wish to supplant the State of Delaware in their responsibilities. Our only desire is to provide the resources of the Philadelphia District to the people of the Christina River Basin and work with the Commonwealth of Pennsylvania and the State of Delaware to achieve a management plan which can offer a realistic prospect for solving specific urban water resources problems.

Appendix 1

NAPEN-R

Mr. Vernon M. Beard

I also wish to extend my thanks for a very informative and productive meeting members of my staff had with you and Mr. Lyon, and your respective staffs, on 18 December 1973. I believe we are now starting to make some progress in establishing a better understanding of our mutual concern for the problems and needs of the Christina River Basin. I would like to outline some of our reactions to the discussions and how we now perceive this study's scope in the Pennsylvania portion of the basin.

We will not direct major study efforts into further investigations of the water resource aspects of the Pennsylvania portion of the Christina River Basin. Our Urban Study emphasis will be toward solving problems in Delaware; however, if an urban water resources problem is determined to be based in the Pennsylvania portion of the basin, we will address the source of the problem to identify feasible solutions. In regard to such feasible solutions we will utilize, to the maximum extent possible, the Commonwealth of Pennsylvania's State Water Plan and Pennsylvania's Comprehensive Water Quality Management Plan. Such investigations would, of course, be done in full consultation with Pennsylvania. The water resource aspects of the Pennsylvania portion of the basin which do not affect Delaware will be addressed only for the purpose of identification and inventory. The Commonwealth's, as well as other agencies, existing efforts, will be utilized for this identification and resultant inventory.

Those efforts in the Pennsylvania portion of the basin which our Christina Urban Study will become involved in will be those proposed at the 18 December 1973 meeting. It is our understanding that the proposed role discussed only relates to current State Water Plan efforts and not the Comprehensive Water Quality Management Plan. Since there was some discussion at the 18 December meeting on the proposed role of the Corps, I have outlined below our conception of your proposal for Corps involvement through the Urban Study in the Pennsylvania portion of the Christina River Basin.

- A. Corps of Engineers will examine the potential of ground water recharge.
- B. Corps of Engineers will examine flood control alternatives (structural and non-structural) for all damage areas.
- C. Corps of Engineers will examine the implementation of flood plain management and zoning to solve both present and future flooding problems.

NAPEN-R

Mr. Vernon M. Beard

- D. Corps of Engineers will examine the problems caused by storm water runoff (urban runoff), including storm sewers, and the alternative solutions to these problems.

As you are aware, we are currently preparing a Plan of Study on the Christina River Basin Study. We are looking for completion of this document within the next two months. We would therefore appreciate it if you would review our perception of the role Pennsylvania wishes the Corps of Engineers to undertake in the Pennsylvania portion of the Christina River Basin. In order to develop the Plan of Study so that it responds to our appropriate role, we would appreciate it if you could reply to our request by 6 February 1974. Please make any revisions or modifications as you see fit.

We are also formulating a revised Study-Management proposal, taking into account the results of our meeting with the Department of Environmental Resources, as well as, the State of Delaware, New Castle County, the Environmental Protection Agency, and the Delaware River Basin Commission. This proposal is scheduled to be developed within the next few weeks. We will keep you informed, and will contact your office prior to any firm commitments on our part.

Once again, thank you for meeting with members of my staff. We are looking forward to establishing a good working relationship in this study effort. I will be forwarding a copy of this letter to Mr. Walter A. Lyon, Director, Bureau of Water Quality Management, for his information. If you have any questions regarding this letter please contact Mr. James J. Smyth, Chief of my Basin Planning Section, Planning Branch. He may be reached at (Area Code 215) 597-4713.

Sincerely yours,

/S/ C. A. SELLECK, JR.  
Colonel, Corps of Engineers  
District Engineer

Cy Furn:  
Mr. Walter A. Lyon

COMMONWEALTH OF PENNSYLVANIA



DEPARTMENT OF ENVIRONMENTAL RESOURCES

P. O. BOX 1467  
HARRISBURG, PENNSYLVANIA 17120

In reply refer to  
RM-R  
F 15:3

February 8, 1974

Col. Clyde A. Selleck, Jr.  
District Engineer  
Philadelphia District - Corps of Engineers  
Custom House - Second and Chestnut Streets  
Philadelphia, Pennsylvania 19106

Dear Colonel Selleck:

We have reviewed your recent letter with regard to the Christina Basin Study. We are quite pleased with the new direction of the study and your plans for managing it.

As you are probably aware, in addition to the State Water Plan investigations in this Basin, the Soil Conservation Service is actively engaged in reexamining the Brandywine Basin plan. They have recently supplemented the work plan agreement in order that the flood control dam on Beaver Creek above Downingtown can be constructed. With this project, the flood problems on the East Branch of Brandywine Creek will be nearly eliminated. They are now engaged in detailed investigations on the Ice-dale Project as well as examining many other alternatives to solve the problems on the West Branch of Brandywine Creek.

In effect, then, the main problem in the Pennsylvania portion of the Christina Basin which would warrant any investigations in the urban study would be problems in and around Coatesville and Downingtown. With this in mind, we would revise your proposed role for the Pennsylvania portion of this Basin to be the following:

- A. Corps of Engineers will examine the potential of ground water recharge.
- B. Corps of Engineers will examine the problems caused by storm water runoff including storm sewers in the urban areas of Coatesville and Downingtown. Also, flood plain information and zoning should be explored as well as other possible structural and non-structural measures taking into account the effects of the Soil Conservation Service work plan.

Appendix 1

Col. Clyde A. Selleck, Jr.

- 2 -

February 8, 1974

From what we have been able to determine, the Soil Conservation Service work plan is supposed to eliminate 95% of the average annual flood damages in the Brandywine Basin and the storm drainage problems within Coatesville and Downingtown are not too extensive and to some degree, are being solved locally. Therefore, we would expect that your study would pick up where others have left off. Also, the quantitative aspects of urban drainage should be integrated with the water quality aspects.

If there are further areas identified in the State Water Plan that we feel you could help, we will let you know.

Sincerely yours,



V. M. Beard, Director  
Bureau of Resources Programming



DEPARTMENT OF THE ARMY  
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS  
CUSTOM HOUSE-2 D & CHESTNUT STREETS  
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO  
NAPEN-R

\*\*\*\*\*  
\*COPY\*  
\*\*\*\*\*

8 March 1974

Mr. N. C. Vasuki, Director  
Division of Environmental Control  
Department of Natural Resources and  
Environmental Control  
Dover, Delaware 19901

Dear Mr. Vasuki:

This is in reference to the Philadelphia District's Urban Study of the Christina River Basin, and the scope of the Corps of Engineers' involvement as it relates to other water resources planning efforts in the State of Delaware.

The Christina Urban Study seeks to provide, through joint study efforts, a range of implementable urban water resources plans which result from an integrated approach to specific problems and needs. It is not the intent of this office to supplant the State of Delaware in its leadership role in the comprehensive planning for the people of Delaware. Likewise, since the Christina Study involves areas in Pennsylvania, we do not wish to supplant the Commonwealth of Pennsylvania in its responsibilities. Our only desire, in this study effort, is to provide the resources of the Philadelphia District to Delaware and Pennsylvania and work together toward achieving a management plan which can offer a realistic prospect for solving specific urban water resources problems.

As you are aware, we had experienced some difficulty in defining this study's scope and its relationship to the current water resources planning studies being conducted by the Commonwealth of Pennsylvania. We have been in contact with representatives of Pennsylvania and believe we have satisfied their concerns. Based on discussions with representatives of Pennsylvania, we will not undertake major studies in the Pennsylvania portion of the Christina River Basin. This office will direct the major portion of the study's efforts into investigations of the water resources problems in the State of Delaware. While our Urban Study's emphasis will be toward solving problems in Delaware, if an urban water resources problem in Delaware is determined to be based in

Appendix 1

8

BUY U. S. SAVINGS BONDS REGULARLY ON THE PAYROLL SAVINGS PLAN

NAPEN-R

Mr. N. C. Vasuki

the Pennsylvania portion of the Christina River Basin, we will address the source of the problem to identify feasible solutions. Such investigations would, of course, be done in full consultation with Pennsylvania.

As you are aware, there have been a number of coordinating meetings held on the Christina River Basin Study to discuss the scope of the study. Mr. James Pase of your office has attended these meetings as a representative of the State of Delaware. In addition we are also in receipt of several letters from your office regarding the various problems and needs and the study's proposed scope. Based on this input, as well as input from recent meetings with New Castle County, the Environmental Protection Agency, the Commonwealth of Pennsylvania Department of Environmental Resources, the Delaware River Basin Commission, and our higher authority, we have formulated a position as to the role the Corps of Engineers can undertake in assisting Delaware in the Christina River Basin Urban Study. Our views are outlined in the following paragraphs. These paragraphs cover the study purposes of flood water and flood plain management, water supply, wastewater management, water quality management, water related recreation, and navigation.

The Corps of Engineers will investigate the flooding and flood plain management problems in the Delaware portion of the Christina River Basin. Both structural and non-structural flood control solutions will be developed. Structural solutions investigated will include the normal range of protective measures. Non-structural solutions investigated will include, but not be limited to, flood forecasting and flood warning systems, evacuation, zoning, subdivision regulations, and building codes. These investigations will include problems relating to storm water runoff and urban drainage. The Corps' efforts in urban drainage control will only be toward solving the related flooding problems. Under this purpose we will not be addressing the water quality problems which might result from such urban runoff. However, as an important part of our investigations, the impact of any proposed solutions on the water quality of the streams will be investigated. In addition to limiting our flood control and flood plain management role to the quantity aspects of water, we should also point out a limitation on the level of detail our efforts can take. With regard to traditional Corps' flood control investigations, we are directed by Congress to provide planning services at a detailed project planning level. However, our authorities are limited in the area of urban drainage control. The responsibility for the detailed planning, design and construction of storm water systems rests with the State of Delaware and other local interests. Our role in flood control and flood plain management, as it relates to urban drainage, cannot proceed to the detailed levels outlined above.

Regarding water supply, New Castle County has a study of its water supply problems currently underway. This study is being done jointly with Chester County, Pennsylvania. Therefore, we see the major portion of this urban study effort being the responsibility of New Castle County with supplemental



NAPEN-R

Mr. N. C. Vasuki

input from the Corps of Engineers. Based on our present knowledge of New Castle County's efforts, the Corps' input would consist of the following:

- a. Investigation of the adequacy of the existing water distribution system.
- b. Determination of power industry requirements.
- c. Determination of available water supplies in the basin.
- d. Feasibility studies of specific alternative solutions to include desalination plants, interbasin transfer, and flood skimming.

In the area of wastewater management, it is our understanding that the State of Delaware will designate New Castle County as the organization responsible for developing areawide waste treatment management plans. As the organization designated under Public Law 92-500, New Castle County would be responsible for wastewater planning, and would receive Environmental Protection Agency funding through Public Law 92-500 appropriations. Based on such a designation we see the wastewater management portion of the urban study effort being done by New Castle County. However, this office could function as a consultant to New Castle County for portions of this effort, if it was so desired. However, we would have to be requested to do so before we could expand our involvement to include this purpose. We feel we have sufficient interest and expertise to act as a consultant to New Castle County in such areas as water quality modeling of the Christina River Basin's streams; hydrologic investigations as they relate to solution of water quality problems caused by urban storm runoff; identifying and evaluating the formation, extent and effects of non-point pollution sources; and evaluating the land treatment and disposal alternative. Should New Castle County desire our input, we would have to make appropriate funding arrangements between the agencies involved.

Giving consideration to the State of Delaware's current efforts in the field of water quality management, we see the State of Delaware being responsible for this study's water quality efforts. We do, however, see a role for the Corps to act as a consultant to Delaware in this purpose. The Corps' input as we presently view the need lies in the development of a water quality/quantity model. This model could then be used for the assessment of future development programs and policies, and their effect on the water resources of the basin. Further consideration must be given to our involvement in such water quality studies since they directly, and very closely, relate to planned wastewater management studies.

Regarding recreational development studies, we would look to the Delaware State Planning Office's "Delaware Comprehensive Outdoor Recreation Plan" for input. As we see it, the urban study should focus on providing recreational facilities, preserving open space areas, and conserving fish and wildlife

NAPEN-R  
Mr. N. C. Vasuki

resources within the context of plans developed for other purposes. In keeping with the Recreation Plan's findings, the Corps would investigate the possibility of recreational development in conjunction with potential projects formulated for the purposes for which we are responsible. In addition, we would broaden this scope to include basin-wide recreational needs and investigate how individual projects formulated under other study purposes can be best planned to meet the State's water-related recreational demands. This analysis should include consideration of the multi-objective approach, with recreation as a co-equal planning objective in individual project development.

The development of a comprehensive navigation investigation is, in general, beyond the scope of the Christina River Basin Study. The commercial navigation needs of the Christina River would be better met by a separate study concerned entirely with navigation. However, the Corps will address in this study the problems of sedimentation and siltation as they pertain to the shoaling of the navigation channel in the Christina River, and the availability of long-term spoil disposal sites.

Regarding sediment and erosion, you will notice that we have not combined them together as a separate study purpose. The reason is that sedimentation and erosion are problems which affect many water resources purposes. They affect water quality from an aesthetic and bio-chemical viewpoint; water supply as a result of additional treatment cost, as well as, a reduction of storage capacity of reservoirs; flood control from increased flood levels resulting from obstructed and silted flow channels; and navigation as a result of siltation of navigation channels. It is evident that different water resources purposes (i.e., water quality, flood control, etc.) are concerned with different aspects of sedimentation and erosion. Therefore, we feel that the best way to handle sedimentation and erosion is to investigate them within the study purposes already outlined. In addition, it should be pointed out that under Public Law 92-500 the designated Section 208 planning agency has to address the problems of non-point sources of pollution. Sedimentation, of course, is one of many non-point pollutants and therefore would have to be addressed by New Castle County in its investigations. As we have already pointed out, we feel that we can provide assistance in this area, should New Castle County desire and request our input.

The proposed role for the Corps of Engineers generally falls into two broad areas of responsibility. For some purposes we would be the agency responsible for both the planning and technical efforts involved. For other purposes, other agencies, either the State of Delaware or New Castle County, would be responsible for the planning and the Corps would provide technical input through services rendered. It is important, especially in this latter role, that certain uniform standards and criteria be followed in the planning and evaluation of any programs or projects considered in this joint urban study effort. This is required to insure that all agencies involved will be

NAPEN-R

Mr. N. C. Vasuki

working toward an achievable common objective, and to insure that all programs and projects can be fairly evaluated for possible reception of Federal construction fund grants or Corps of Engineers project authorizations. It is our feeling that such a requirement is a vital element of a truly joint study effort.

As you are aware, we are currently preparing a Plan of Study on the Christina River Basin Study. We are looking for completion of this document within the next four weeks. We would therefore appreciate it if you would review our perception of the type of role Delaware wishes the Corps of Engineers to undertake in the Delaware portion of the Christina River Basin. We realize that the specific details of our role, and likewise the role of other agencies, must still be delineated. However, we would appreciate it if we could have some statement as to the State's endorsement of the Corps of Engineers' involvement as defined by this letter. We are attempting to transmit our Plan of Study to our higher authority by 31 March 1974, and would like to document the state's involvement and endorsement in the general scope of the study and in the type of role the Corps of Engineers will have. At the same time we need to document our funding requirements as they presently exist. In order that this may be accomplished, we would appreciate it if you could reply to this request by 25 March 1974. Please make any modifications or revisions as you see fit.

In finalizing this Plan of Study, we will be taking into account the results of the many coordination meetings we have held with the various governmental units involved. The document is being developed around the type of roles outlined in this letter. This document will of course be considered preliminary until we receive a statement of your endorsement. However, in order to expedite development of the Plan of Study, we will be forwarding sections of this document for your informal review. These sections will be transmitted under separate cover and will be available within the next few weeks.

We are looking forward to working with the State of Delaware in a joint study of the Christina River Basin, and hope that the appropriate agency roles can be established so that we can begin actual study efforts. In order to facilitate exchange of information, we will be forwarding a copy of this letter to Mr. James L. Pase, Planning Supervisor, Water Resources Section. We will also be transmitting a similar letter to New Castle County, since they are also actively involved in current water resources planning efforts in the Christina River Basin.

NAPEN-R

Mr. N. C. Vasuki

Should you have any questions regarding the information contained in this letter, please contact Mr. James J. Smyth, Chief of my Basin Planning Section, Planning Branch. He may be reached at (Area Code 215) 597-4713.

Sincerely yours,

/s/

C. A. SELLECK, JR.  
Colonel, Corps of Engineers  
District Engineer

Cy Furn:

Mr. James L. Pase



STATE OF DELAWARE  
DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL  
Dover, Delaware 19901

John C. Bryson  
Secretary

Division of Environmental Control  
N. C. Vasuki, Director

April 16, 1974

Colonel C. A. Selleck, Jr.  
Corps of Engineers  
District Engineer  
Custom House - 2d and Chestnut Streets  
Philadelphia, Pennsylvania 19106

Re: NAPEN-R

Dear Colonel Selleck:

This is in reply to your letter of March 8, 1974 regarding the Urban Study of the Christina River Basin and the scope of the Corps of Engineers' involvement as it relates to other water resources planning efforts in the State of Delaware.

We believe that the working arrangement stated in your letter between the Corps of Engineers and the State of Delaware for initiating and carrying out this study is appropriate and commendable.


We believe that the appropriate initial step in this study process is to formalize the relationship of all parties of the study. To accomplish this, it is recommended that a policy board be created. This policy board would have final policy, program and plan approval rights over the study.

We suggest that representation on the policy board could consist of the Corps of Engineers, Delaware River Basin Commission, New Castle County and the State of Delaware.

We will be pleased to endorse the concept of the study at this time. We suggest that the plan of study be prepared with the assistance of the policy board.

If you should require additional information or further clarification, please contact us.

Sincerely,

  
N. C. Vasuki,  
Director

NCV:JLP:cnk

Appendix 1 cc: Mr. John C. Bryson  
14 Mr. Lee J. Beetschen

**PUBLIC WORKS DEPARTMENT**

Albert W. Madora  
Director



**ENGINEERING BUILDING**

2701 Capitol Trail  
Newark, Del. 19711  
302-737-4100

May 16, 1974

Colonel C. A. Selleck, Jr.  
District Engineer  
Philadelphia District  
Corps of Engineers  
Custom House  
2nd & Chestnut Streets  
Philadelphia, Pennsylvania 19106

Dear Colonel Selleck:

Recent correspondence from the Corps concerning the Urban Study of the Christina River Basin has requested that New Castle County endorse the proposed study effort of the Corps as outlined in a previous letter of March 13, 1974. In addition, the Corps has forwarded sections of the Plan of Study document to Merna Hurd for review and comment.

The planning agencies in this region have emphasized a multitude of times that the Corps Study undertaken cannot duplicate ongoing studies and programs. Several specific study area needs have been defined.

However, the Plan of Study indicates duplication of many of our study effects, and a very general approach in lieu of in-depth analysis required by the existing water resource problems. The 208 Water Quality Management Plan, the State Water Plan, the County Water Plan, and planning efforts undertaken by the Departments of Parks and Recreation, Planning and Public Works addresses many of the areas outlined in the proposed Corps Study. New Castle County will submit a 208 grant application by June 1, 1974. The EPA Grant, through Public Law 92-500 appropriations, will provide for comprehensive wastewater management planning by the County. The Study will be directed by County staff, and consulting assistance has not yet been selected. At this time, the County is not requesting assistance from the Corps of Engineers.

Appendix 1

Recently, the North Atlantic Division of the Corps proposed an additional Water Resource Study under Section 22 of the Water Resources Development Act of 1974 for the State of Delaware. How is this plan being coordinated with the Urban Studies Program?

We are of the opinion that with the requirements on staff time dealing with ongoing planning programs, the staff time that would be required for study participation, and the duplication of efforts in review and interpretation of various studies, the Corps proposal is not the best utilization of public funds. New Castle County concurs with the State of Pennsylvania that major studies should not be undertaken by the Corps in the Christina River Basin. The Urban Studies Program is not adaptable to the needs of the area and therefore, should not be continued.

Thank you for your efforts in undertaking this endeavor.

Very truly yours,

*Melvin A. Slawik*

Melvin Slawik  
County Executive

MS:MH:lpm

cc: Senator Joseph Biden  
Senator Pierre S. Dupont  
Senator William Roth  
Henry Folsom  
Albert Madora  
Richard Bauer  
N. C. Vasuki  
Edward O'Donnell  
Stephen Sue  
Patricia Schram  
Robert Varrin  
Howard Miller  
Herb Howlett



IN REPLY REFER TO  
NAPEN-R

DEPARTMENT OF THE ARMY  
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS  
CUSTOM HOUSE-2 D & CHESTNUT STREETS  
PHILADELPHIA, PENNSYLVANIA 19106

\*\*\*\*\*  
\*COPY\*  
\*\*\*\*\*

28 June 1974

Mr. N. C. Vasuki, Director  
Division of Environmental Control  
Department of Natural Resources  
and Environmental Control  
Dover, Delaware 19901

Dear Mr. Vasuki:

During the past several weeks the scope of the Corps of Engineers' involvement in water resources planning efforts in the Christina River Basin has been significantly redefined. Specifically, your meeting of 31 May 1974 with Mr. Murphy and Mr. Yuschishin of this office and your letter of 7 June 1974 outlined for us the State's position as to what type of involvement would be an appropriate Corps' role. Similarly, the 13 June 1974 meeting between representatives of the State of Delaware, New Castle County, Senator Biden's office and this office did much to crystalize the State's position and obtain, what appears to be, concurrence on the part of those present to the redefined Corps' role.

Outlined below is our understanding of the present Corps of Engineers' role. I believe this is consistent with your 7 June 1974 letter. If you agree, the statements contained in this letter could constitute a basis upon which our Urban Study could proceed and be made more responsive to the needs of the ground and surface water management program being undertaken by the State of Delaware.

The primary responsibility of developing and implementing a comprehensive water resources plan rests with the State of Delaware. The Corps' role will be secondary in nature. Specifically, the Corps will be responsible for developing plans and providing assistance in specific areas of the water resources spectrum. Any plans developed or any assistance provided will serve as input to the comprehensive water resources plan. In this regard, the Corps' role will be divided into two distinct areas of involvement. One area of involvement will be to conduct a traditional Corps' water resources investigation of the Delaware portion of the Christina River Basin,

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Mr. N. C. Vasuki

including tributary streams. Our accent will be to provide input to the State's comprehensive water resources plan in the area of flood control and flood plain management. Your letter of 7 June suggested limiting such a study to the Upper Christina Basin; however, New Castle County, at the 13 June meeting, stressed the point that flooding problems exist throughout the County. If you agree, we would expand the scope of your 7 June letter to include the entire Basin. Our second area of involvement would be to assist the State and other planning agencies by conducting specialized planning studies in the Christina River Basin. Those studies, which are as yet undefined, could be similar to the Urban Studies items numbered 1, 2, and 4 in your 7 June letter. The nature of this role is to provide planning and technical assistance to the State in its efforts to develop a comprehensive water resources plan.

In regard to the first area of involvement, we can provide the needed input to the State plan through our existing study authority. In the second area of involvement, we must, because of the present undefined nature of the studies, qualify our agreement to undertake such efforts. The conditions under which we can undertake the studies are outlined below. However, let me hasten to add that it is this office's desire to assist the State by conducting such studies. The general thrust of the qualifying conditions deal with our commitment of insuring that all Corps' efforts will be incorporated within the overall comprehensive water resources plan, insuring the wise expenditure of Federal funds and avoiding the duplication of effort. The qualifying conditions include:

- a. Prior to scheduling and undertaking any specialized study, a description of the scope of work required should be furnished to this office. We will need such a scope of work to determine if we have the capability to do the study, to estimate its cost, to schedule our efforts, to evaluate its impact on other studies, and to request appropriate funding. In addition, the scope of each specialized study should be developed so that Corps' participation is product, not service, oriented. In other words, the Urban Studies Program is a planning program with implementation capabilities and as such should be utilized for planning efforts, not just data collection or pure research.
- b. Prior to scheduling and undertaking any specialized study, we will need information on the State's overall water resources program and the relationship of each specialized study to it. One of the objectives of the Urban Studies Program is to aid in development of a coordinated, comprehensive urban water resources plan. This office feels that our specialized planning studies should meet this objective.

NAPEN-R

Mr. N. C. Vasuki

- c. Prior to scheduling or undertaking any specialized study, we would appreciate a statement from the State that such a study is not a duplication of any past or on-going effort. All of our specialized planning studies should be oriented toward furthering the water resources plan for Delaware, not re-doing past efforts.
- d. Prior to scheduling or undertaking any specialized study dealing in the areas of water quality or wastewater management, it is considered that an agreement should be made between the State, the designated 208 planning agency (New Castle County), EPA and the Corps. The purpose of such an agreement will be to insure that no duplication of effort or funding takes place in regards to planning assistance grants.

Please understand that the above-mentioned conditions are not meant to limit our involvement. We believe that these conditions are needed to insure that our present commitment to do specialized studies will not result in studies which conflict with the overall Corps of Engineers' mission, the Urban Studies Program's objectives, or our Congressional Resolution.

As you are undoubtedly aware, this office cannot proceed with any major study efforts until we obtain an agreement of our appropriate role, finalize our Plan of Study and obtain approval of the Plan of Study. It is important that this recent redefinition of the Corps' role be formalized, that the details of our specific involvement be developed and that the Plan of Study be forwarded to our higher authority for approval in the very near future. To be specific, we must furnish the Plan of Study by mid-August 1974. Members of this office would be available to meet with you and assist in the development of your proposal. Arrangements for such a meeting can be made by contacting Mr. John F. Murphy, Chief of my Planning Branch. He may be reached at (Area Code 215) 597-4837.

Sincerely yours,

/s/ C. A. SELLECK, JR.  
Colonel, Corps of Engineers  
District Engineer

Cy Furn:  
Mr. James Pase



IN REPLY REFER TO  
NAPEN-R

DEPARTMENT OF THE ARMY  
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS  
CUSTOM HOUSE-2 D & CHESTNUT STREETS  
PHILADELPHIA, PENNSYLVANIA 19106

21 March 1975

Mr. Benny Martin \*/  
State Conservationist  
U.S. Department of Agriculture  
Soil Conservation Service  
Box 985, Federal Square St.  
Harrisburg, Penna. 17108

Dear Mr. Martin:

The purpose of this letter is to confirm the major points discussed at a meeting held on 21 February 1975 at the Chester County Water Resources Authority's office in West Chester, Pennsylvania. That meeting was held to discuss certain aspects of this office's Christina River Basin Study. The following people were in attendance:

- a. Mr. David Yaeck - Executive Director, Chester County Water Resources Authority
- b. Mr. Stephen Runkle - Commonwealth of Pennsylvania Department of Environmental Resources
- c. Mr. Arthur G. Manwiller - Project Coordinator, Borough of Downingtown
- d. Dr. Eugene Coggins - Chairman, Brandywine Steering Committee
- e. Mr. Louis Kirkaldie - Watershed Work Plan Staff Leader, Soil Conservation Service
- f. Mr. James Smyth, Chief, Basin Planning Section, Corps of Engineers
- g. Mr. Myron Yuschishin - Study Manager, Christina River Basin Study, Corps of Engineers.



NAPEN-R

Mr. Benny Martin

As you know, the Corps of Engineers has been directed by a U.S. Senate Resolution to investigate the water resources problems in the Christina River Basin to determine if Federal Improvements are advisable. The area encompassed by the study includes portions of Pennsylvania, Delaware and Maryland. Through past coordination with various Federal, regional, state, and local agencies, it had been determined that the only water resources problems not being solved or addressed by other on-going efforts were flooding problems in the Delaware portion of the Basin and in two urban areas in Pennsylvania. The areas in Pennsylvania are the City of Coatesville and the Borough of Downingtown. The purpose of the 21 February meeting was three-fold: one, to determine the extent of the flooding problems in Coatesville and Downingtown, two, to outline in more detail what is required of the Corps of Engineers in Pennsylvania, and three, to determine the relationship between the Christina River Basin Study and the other on-going water resource efforts in Pennsylvania.

The major points surfacing during the course of the meeting included:

- a. The Borough of Downingtown is presently experiencing minor flooding problems within its boundaries. Both the Soil Conservation Service and the Chester County Water Resources Authority believe these problems would be greatly alleviated with the full implementation of the Brandywine Watershed Work Plan on the East Branch of the Brandywine Creek.
- b. The Soil Conservation Service stated that they had recently re-analyzed the hydrology for the East Branch and were planning to conduct a new damage survey to supplement the original one undertaken in 1962 to determine if additional flood protection for the Borough of Downingtown was feasible.
- c. The Soil Conservation Service stated that they were planning to re-analyzed and re-evaluate the Brandywine Watershed Work Plan for the West Branch of the Brandywine Creek which would include new damage surveys, hydrologic and hydraulic analyses, and consideration of additional flood control alternatives. Such an analysis would address flooding problems in the City of Coatesville.
- d. The Chester County Water Resources Authority stated that the water resources problems in the Pennsylvania portion of the Christina River Basin were being solved or addressed by on-going efforts of the Soil Conservation Service, the Commonwealth of Pennsylvania, and the Chester County Water Resources Authority.

NAPEN-R

Mr. Benny Martin

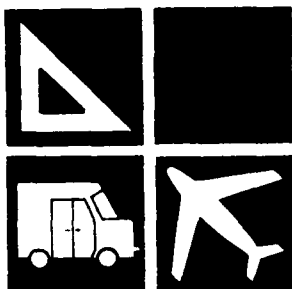
e. It was agreed by those present that full coordination would be maintained between the on-going planning efforts of the Soil Conservation Service, the Commonwealth of Pennsylvania, Chester County, and the Corps of Engineers.

Based on discussions at the meeting, it appears that investigations by the Corps of Engineers to develop solutions to flooding problems in the Pennsylvania portion of the Christina River Basin are not needed. The Corps' role in Pennsylvania, insofar as the Christina River Basin Study is concerned, would be limited to work required to develop solutions to the flooding problems in the Delaware portion of the Basin, and to coordinate this office's study with the other on-going water resources efforts in Pennsylvania. I would appreciate your views as to this office's perception of the above role. If you have any questions, please do not hesitate to contact me.

Sincerely yours,

C. A. SELLECK, JR.  
Colonel, Corps of Engineers  
District Engineer

\*/ Similar letters were sent to the Commonwealth of Pa., Chester County, City of Coatesville, and the Borough of Downingtown. This letter documents the Corps' role in Pa. which, in effect, is limited to coordination.



## New Castle County Department of Public Works

Mary D. Jornlin  
County Executive

2701 Capitol Trail  
Newark, Delaware 19711

Albert W. Madora  
Director

(302) 366-7800

July 6, 1977

Colonel Harry V. Dutchyshyn  
District Engineer  
U.S.A. Corps of Engineers  
Custom House  
Second and Chestnut Streets  
Philadelphia, Pa. 19106

Dear Colonel Dutchyshyn:

This is to advise you that New Castle County is not interested in financially participating in the Little Mill Creek Drainage Project.

Very truly yours,

Albert W. Madora  
Director

AWM:mte

cc: Mr. Tim Blankenhorn



IN REPLY REFER TO  
NAPEN-R

DEPARTMENT OF THE ARMY  
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS  
CUSTOM HOUSE-2 D & CHESTNUT STREETS  
PHILADELPHIA, PENNSYLVANIA 19106

\*\*\*\*\*  
\*COPY\*  
\*\*\*\*\*

27 Jul 1977

Mr. David C. Yaeck, Executive Director  
Chester County Water Resources Authority  
314 Farmers and Mechanics Building  
West Chester, PA 19380

Dear Mr. Yaeck:

This is in reference to the flood control study of the Christina River Basin, New Castle County, Delaware. We are nearing completion of Stage II of the study. Of the 32 damage areas which were identified, 13 were designated as major, and required study. More than 80 alternative flood control plans were investigated, including both structural and non-structural measures. Where applicable, we also identified the potential for developing water supply and recreation.

Attached are fact sheets (Inclosure 1) on the plans which can be considered for further study. We need your input particularly in regard to those plans which would either impact Chester County or would require the County's cooperation (Plans FW-1 and SW-1). We request that you provide us with your input by 19 August 1977.

Our second request concerns multi-purpose reservoir plans on Red Clay Creek (Plan R-10B) and White Clay Creek (Plan R-11B). Information on these plans are presented in Inclosure 2. We are not considering these plans for further study. We have completed our study goals for water supply and recreation with the identification of these potential sources. We request that you advise us whether the County is interested in participating in the sponsorship of these reservoir plans. Please let us know your decision by 19 September 1977. For your information the State of Delaware and New Castle County also have been asked if they are interested in these plans.

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Mr. David C. Yaeck

If you wish to discuss this inclosed material or any other aspects of our study, we ask that a meeting be scheduled by 12 August 1977. Please call Mr. Paul Gaudini, Study Manager for the Christina River Basin Study, to make arrangements for further coordination. In the meantime, if you have any questions or wish additional information you may reach Mr. Gaudini by calling (Area Code 215) 597-4714.

Sincerely yours,

2 Incl  
As stated

/s/WORTH D. PHILLIPS  
Chief, Engineering Division





IN REPLY REFER TO  
NAPEN-R

DEPARTMENT OF THE ARMY  
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS  
CUSTOM HOUSE-2 D & CHESTNUT STREETS  
PHILADELPHIA, PENNSYLVANIA 19106

\*\*\*\*\*  
\*COPY\*  
\*\*\*\*\*

27 Jul 1977

Miss Mary D. Jornlin  
New Castle County Executive  
800 King Street  
Wilmington, DE 19801

Dear Miss Jornlin:

This is in reference to the flood control study of the Christina River Basin, New Castle County, Delaware. We are nearing completion of Stage II of the study. Of the 32 damage areas which were identified, 13 were designated as major, and required study. More than 80 alternative flood control plans were investigated, including both structural and non-structural measures. Where applicable, we also identified the potential for developing water supply and recreation.

Many of the plans investigated do not warrant further study. Attached are fact sheets (Inclosure 1) on the plans which can be considered for further study. We need your input particularly in regard to local sponsorship of these plans.

Our first request concerns local assurances. Timely completion of study depends on determination of the "implementability" of each plan. Implementation depends on decisions which can only be made by the non-Federal governments and citizens of the affected areas. These decisions relate to two key questions.

a. Do the communities want the types of plans which are being proposed for further study?

b. Will the non-Federal interests meet the non-Federal administrative and financial requirements?

If New Castle County wants the types of plans presented in Inclosure 1 and if the County is willing to meet the non-Federal requirements, then "local assurances" must be provided. At this stage in the study we are asking you for a letter stating that you want a plan or plans and that the County is willing to participate in them. The non-Federal participant would be required to provide all lands, easements, and

Appendix 1

NAPEN-R

Miss Mary D. Jornlin

rights-of-way; utility, bridge and highway relocations; and operation and maintenance of the project. A current cost estimate for this work is included in the "Effect Assessments" table presented for each plan. We request that you notify us by 19 August 1977 as to which plan or plans the County is willing to provide local assurances.

Our second request concerns multi-purpose reservoir plans on Red Clay Creek (Plan R-10B) and White Clay Creek (Plan R-11B). Information on these plans is presented in Inclosure 2. We have completed our study goals for water supply and recreation with the identification of these potential sources. We request that you advise us whether the County is interested in sponsoring these reservoir plans. Please let us know your decision by 19 September 1977.

It is not our purpose to identify the sole sponsor for these plans since more than one local government may act as a sponsor. At this time, we wish to identify those who would be interested and willing to sponsor or even co-sponsor these plans. The State of Delaware has also been asked if they wish to sponsor the flood control plans (Inclosure 1). The Cities of Wilmington and Newark have been asked if they wish to sponsor those plans which are located in their respective municipalities. Only New Castle County, the State of Delaware, and Chester County in Pennsylvania have been asked to comment on our position regarding the multi-purpose reservoir plans.

We believe that it would be mutually beneficial that we discuss the entire Christina River Study as well as the inclosed material. We would like to meet with you prior to 12 August 1977. We will also make ourselves available to assist you in coordinating and presenting our work and findings to the appropriate members of your staff, County officials, or other individuals who will be involved in developing a County position.

Please call Mr. Paul Gaudini, Study Manager for the Christina River Basin Study, to make arrangements for further coordination. In the meantime, if you have any questions or wish additional information you may reach Mr. Gaudini by calling (Area Code 215) 597-4714.

Sincerely yours,

2 Incl  
As stated

/s/ WORTH D. PHILLIPS  
Chief, Engineering Division

Cy Furn: w/incl  
Mr. Albert W. Madora  
Director of Public Works  
Ms. Merna Hurd  
Water and Sewer Management Officer

Appendix 1

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STATE OF DELAWARE  
EXECUTIVE DEPARTMENT

OFFICE OF MANAGEMENT, BUDGET, AND PLANNING  
DOVER, DELAWARE 19901

OFFICE OF THE  
DIRECTOR

PHONE: (302) 678-4271

Ref.: 1015/1401

August 3, 1977

Mr. Worth D. Phillips  
Chief  
Engineering Division  
Department of the Army  
Philadelphia District  
Corps of Engineers  
Custom House  
2 D & Chestnut Streets  
Philadelphia, PA 19106

Dear Mr. Phillips:

I am writing in regard to your letter of July 14, 1977, concerning the Little Mill Creek flood control project. I wish to inform you that the State bond authorization for this project was withdrawn by the General Assembly in June 1976, apparently because of termination of your small projects program.

Since that time, emerging fiscal problems and the resultant readjustment of capital spending priorities have made participation in this project highly unlikely in the foreseeable future. New Castle County's withdrawal from financial participation makes such participation by the State prohibitive.

In addition, the existence of the Federal Flood Insurance Program and the eligibility of the residents in the Elsmere area for such insurance makes the need for additional governmental expenditures for flood protection less necessary.

It is my recommendation, therefore, that this project be terminated and the remaining federal funds be diverted to worthwhile projects elsewhere.

Sincerely,

A handwritten signature in dark ink, appearing to read "Nathan Hayward, III".

Nathan Hayward, III  
Director

NH/BC/np

# CHESTER COUNTY WATER RESOURCES AUTHORITY

314 Farmers & Mechanics Building  
WEST CHESTER, PENNSYLVANIA 19380  
215-692-7878

## DIRECTORS

William H. Funk, *Chairman*  
James A. Umble, *Vice Chairman*  
G. Pownall Jones, *Secretary*  
Paul W. Baker, *Treasurer*  
J. Deaver Alexander, M.D.  
Eugene J. Coggins, M.D.  
Charles H. Gable  
Ralph D. Heister, Jr.  
Harvey C. Worthington

DAVID C. YAECK  
*Executive Director*

August 8, 1977

Mr. Worth D. Phillips  
Chief, Engineering Division  
Philadelphia District, Corps of Engineers  
Custom House, 2nd & Chestnut Streets  
Philadelphia, Pennsylvania 19106

Dear Mr. Phillips:

The board of directors of the Chester County Water Resources Authority has carefully reviewed the Flood Control and Water Supply elements of the Christina Basin Study prepared by your office under date of July 27, 1977.

In your letter of transmittal, you asked for comments on the first section by August 19 and the second by September 19. Following careful study and discussion of the proposals cited as FW-1, SW-1, R-10B and R-11B, the position of Chester County has been developed.

FW-1 is an interesting proposal and should be explored further, providing no cost to Chester County is involved. Among the elements which need to be defined are operation and maintenance costs, initial capital outlay, ultimate jurisdiction, location and type of equipment and institutional arrangements.

It should also be noted the Corps proposal does not include the placement of sensors above the damage centers of Coatesville and Downingtown in Chester County and does not make note of the existing telemark system operated by the Authority as part of the Brandywine monitoring program.

SW-1 encompasses an area which will be addressed in the newly-launched Chester County Water Resources Inventory which represents a coordinated effort of the Authority and other agencies to develop a sound program for guidance of local and county officials in dealing with water-related problems now and in the future. Therefore, any action on SW-1 should necessarily await the further development of the county activity in order to determine any beneficial inter-relationship which can be gleaned from further study of your suggested storm water alternative.

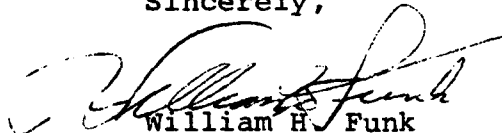
Appendix 1

Mr. Worth D. Phillips  
August 8, 1977  
Page 2

R-10B (multi-purpose reservoir on Red Clay Creek) and  
R-11B (multi-purpose reservoir on White Clay Creek) are opposed  
by the County of Chester.

Thank you for this opportunity to comment on the Christina  
Basin Study. As the county effort moves ahead, the Authority  
looks forward to working with your organization in order to dev-  
elop a meaningful and workable program.

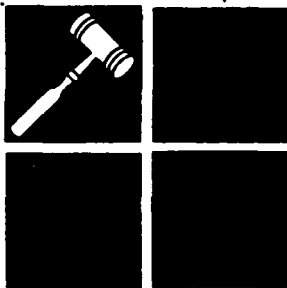
Sincerely,



William H. Funk  
Chairman

WHF:DCY:py

cc Chester County Board of Commissioners



## New Castle County Office of the Executive

Mary D. Jornlin  
County Executive

City/County Building, 800 French Street  
Wilmington, Delaware 19801

(302) 571-7500

August 24, 1977

Mr. Worth D. Phillips, Chief, Engineering Division  
Department of the Army  
Philadelphia District, Corps of Engineers  
Custom House, 2D & Chestnut Streets  
Philadelphia, PA 19106

Dear Mr. Phillips:

The draft Christina River Basin study prepared by the Corps has been reviewed by the Departments of Planning and Public Works. The following comments are offered in response to that study and to your request for "local assurances" that the County may wish to sponsor the types of plans proposed.

In general, we feel that non-structural alternatives--specifically, flood warning systems (FW-1), stormwater management (SW-1), and floodplain zoning (FZ-1)--are the only ones discussed in the Stage II study that deserve further consideration. These alternatives would only be cost-effective, however, if they were to include a technical review of existing floodplain and stormwater management regulations in the river basin (including Chester County) and an evaluation of their effectiveness in minimizing flooding potentials. Problems of enforcement and maintenance of stormwater facilities would have to be dealt with as well. These three alternatives are the only ones described in the study which we feel could be justified in New Castle County and for which we would pledge our qualified support. Financial contributions for any of these alternatives can only be pledged once more details are known and the effects on the County's budget can be analyzed.

Most of the projects we do not feel could be justified in New Castle County because we disagree with the Corps' justification and cost-benefit calculations, in particular the Corps' apparent philosophy concerning the need for and effectiveness of flood control measures and the "benefits" of structural measures. (A position statement describing the County's philosophy on this subject has been enclosed and is briefly summarized here.) The basic question being addressed in the Corps study and in our consideration of the alternatives presented was, how can problems of flooding and the resultant damage to urban property be minimized in the most cost-effective manner possible? The traditional approach, as reflected by the majority of the study alternatives, has been publicly-funded structural works. We feel, however, that such an approach is short-sighted and inadequate because it addresses the flood problems on a case-by-case basis. Furthermore, these flood control practices tend to become self-fulfilling prophecies because they are justified on the basis of future floodplain developments which, as many studies have shown, add to the damage potential and eventual damages in the event of extraordinary flooding.

Appendix 1

Furthermore, the "benefits" are largely private while the costs--project construction, flood relief programs--are essentially public, which raises additional questions as to whether or not the traditional philosophy is equitable as well as effective.

What is needed is an overall, long-range perspective that addresses the causes of flooding rather than the consequences. Such an approach would focus on stormwater management in the watershed and on land use restrictions in and adjacent to the floodplain, including a review of existing policies and regulations of the agencies with jurisdiction over the basin, including federal agencies. We in New Castle County have witnessed programs concerned with flood control and protection work at cross-purposes because of this lack of coordination. The Flood Insurance Program administered by the Department of Housing and Urban Development is one example of a good tool for flood damage control being ineffectively administered because its provisions are not consistently enforced.

This alternative approach--emphasizing land management practices and floodplain restrictions--we feel is not only obviously more cost-effective than publicly-funded structural controls and relief practices, but also more equitable to the public insofar as the responsibility to control flooding is borne by the individual who contributes to it, the responsibility to bear the burden of flooding is borne by the individual who willingly undertook the risk to locate in the floodplain, and the control of flooding is made more a responsibility of local government to prevent rather than of the federal government to correct.

We recognize that such a policy does not address what should be done to alleviate existing flood problems. The Corps study proposed a number of projects to protect existing floodplain uses. However, we were concerned that two of the major flood damage areas in the County--for which structural measures may be the only feasible solutions--were not given consideration in the study. The first of these is the Glenville community, which is located about one-half mile due east of Stanton and which is flooded on a regular basis. The second area is Little Mill Creek, which was intentionally excluded because it was addressed in a separate study. These are the only two areas under the jurisdiction of the County where we think structural alternatives deserve more study although we recognize that the City of Wilmington must address the need for levees in the Brandywine.

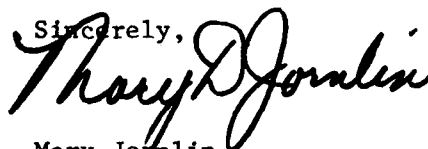
A final aspect of the study with which we take issue, as discussed in the attached position statement, concerns the calculation of costs and benefits for the projects. We feel that the cost-benefit ratio is biased by subjective values and tends to obscure the true costs and benefits because of its built-in bias towards public subsidization of floodplain development.

In summary, New Castle County is interested in developing a comprehensive water management program that considers all aspects of water resources, not just its potential to cause flood damage. We consider that flood warning systems, stormwater management, and floodplain zoning could be part of this comprehensive approach, depending upon how they are undertaken. Flood control structures for the Little Mill Creek and Glenville areas may be necessary as well.

Worth D. Phillips  
Page 3  
August 24, 1977

You also requested our decision on whether we are interested in sponsoring reservoir plans for the Red Clay or White Clay Creeks. As mentioned in the project descriptions, neither can be justified on the basis of flood control benefits alone. We do not believe they can be justified on the basis of water supply benefits either. With regard to the Red Clay Creek, we concur with the comments made by Robert Struble, Executive Director of the Red Clay Valley Association (letter to Ms. Sue Bastress of the Fish and Wildlife Service, dated July 15, 1977 and carboned to Mr. Paul Gaudini of your division). The White Clay Creek dam we do not feel would be justified for water supply reasons because our other alternative--involving the interconnection of the major water suppliers--is considerably more cost-effective for the immediate future and also allows the use of existing filter plant capacity. Other alternatives are being studied to meet long-range demands.

I hope that you find these comments helpful in deciding how best to proceed into Phase III of your study. My staff is ready to offer you assistance as you see fit.

Sincerely,  


Mary Jorlin  
County Executive

Enclosure

cc: Joseph Biden, U.S. Senator, State of Delaware  
Thomas Evans, U.S. Representative, State of Delaware  
William Roth, U.S. Senator, State of Delaware  
Henry Folsom, Council President, New Castle County  
Richard Bauer, Director, Department of Planning, New Castle County  
Albert Madora, Director, Department of Public Works, New Castle County  
Merna Hurd, Project Administrator, New Castle County 208 Program  
David Singleton, Administrative Assistant, City of Wilmington  
Peter Marshall, City Manager, City of Newark  
Peggy Jahn  
Dorothy Miller  
Don Sharp





STATE OF DELAWARE  
EXECUTIVE DEPARTMENT

OFFICE OF MANAGEMENT, BUDGET, AND PLANNING  
DOVER, DELAWARE 19901

OFFICE OF THE  
DIRECTOR

PHONE: (302) 678-4271

Ref.: 1015/4101

October 3, 1977

Mr. Worth D. Phillips  
Chief  
Engineering Division  
Department of the Army  
Philadelphia District  
Corps of Engineers  
Custom House, 2D & Chestnut Streets  
Philadelphia, PA 19106

Dear Mr. Phillips:

This office has completed reviews of the Metropolitan Christina River Basin Study. We have also reviewed New Castle County's Position Statement on Flood Control Projects and endorse it as the State's position as well. By reducing the risk to a few through the construction of publicly owned protective works the financial burden of locating in hazardous areas is being placed on the public. It is our opinion that continued subsidization of floodplain occupancy is not the proper course.

For these reasons the State of Delaware cannot endorse or participate in structural flood control works. If, however, any local government wishes to construct a flood control device, the State would not object, provided it was done under the following conditions:

1. The project should adhere to the Delaware River Basin Commission's floodplain regulations;
2. The project should not cause direct or indirect expenditures to be made by State Government. If, for example, a project were to require relocation of a State highway, such relocation should be accomplished at local expense; and
3. Occupants located in the present 100 year floodplain, who will be protected by any flood control structure, should be required to purchase flood insurance at actuarial rates upon completion of the project. Since flood control structures encourage development of the floodplain, the government should not, in addition to paying for the structure, be held financially responsible for damage resulting from project failure or floods of greater magnitude than the design flood.

With regard to the non-structural aspects of the study we would make the following observations and comments:

Appendix 1

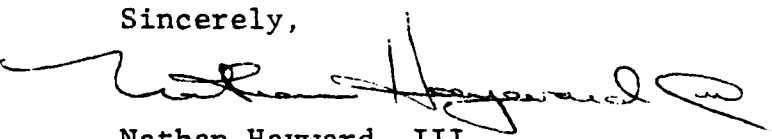
October 3, 1977

1. Alternatives involving the expenditure of public funds for flood proofing or acquisition of flood prone structures should be dropped from further consideration;
2. We feel that the Corps could provide valuable assistance to floodplain regulatory programs by providing the necessary information to accurately define and map the floodplain;
3. The development of building standards for floodplain construction would be helpful. This would be of value in situations where prohibition of floodplain occupancy would constitute a taking without just compensation; and
4. The study should continue to examine flood warning and emergency preparedness alternatives as well as regulatory controls designed to limit further floodplain development.

As a final note, this office is aware that the Corps is required to follow Water Resource Council guidelines when studying or designing water projects. Delaware has in the past objected to the philosophy underlying these guidelines, particularly with regard to the determination of eligible project benefits. Our comments on this, as well as several other recent Corps projects, have reflected this difference of opinion. Until such time as these guidelines are revised to reflect Delaware's position, or at least provide the flexibility to do so, a considerable amount of time, effort and money will continue to be spent on projects which have little chance of construction.

If you have any questions or would like to discuss this matter further, please do not hesitate to contact me. I hope these comments have been helpful.

Sincerely,



Nathan Hayward, III  
Director

NH/BC/np

cc: Joseph Biden, U.S. Senator, State of Delaware  
William Roth, U.S. Senator, State of Delaware  
Thomas Evans, U.S. Representative, State of Delaware  
Mary Jornlin  
Henry Folsom  
Richard Bauer  
Albert Madora  
Merna Hurd  
David Singleton  
Peter Marshall

AD-A144 686

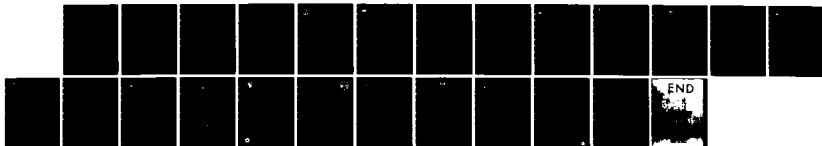
METROPOLITAN CHRISTINA RIVER BASIN(U) ARMY ENGINEER  
DISTRICT PHILADELPHIA PA MAY 82

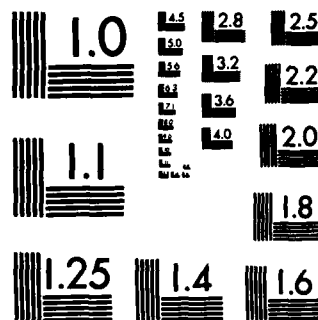
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UNCLASSIFIED

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NL





MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A

# City of Wilmington Delaware



October 14, 1977

## Office of the Mayor

Mr. Worth D. Phillips  
Chief, Engineering Division  
Philadelphia District Corps of Engineers  
Custom House  
2nd & Chestnut Streets  
Philadelphia, PA 19106

Dear Mr. Phillips:

I'm writing in response to your letter of July 27, 1977, concerning the flood control study of the Christiana River Basin. This study has been reviewed by the City's Department of Public Works, Planning and Commerce, and the Directors of these Departments have met with representatives of your office.

The City of Wilmington has experienced serious flooding problems along the Brandywine and Christiana Rivers and is very interested in your proposals for flood relief. The City was disappointed that Damage Area 1A was not recommended for more extensive treatment than flood proofing. The City feels there are significant social and economic benefits to be gained from flood relief in this area since it includes both port facilities and industrial areas. These are vital not only to Wilmington but to the entire region. We recognize that damage in this area is caused by tidal flooding, that projects for relief of tidal flooding require more extensive local funding participation, and that your preliminary analysis has not produced sufficient cost/benefit ratios. However, I hereby request that further studies of flood walls, dredging, and other options be undertaken with the City having the opportunity to provide additional economic information.

Similarly, while we are very interested in Proposals 1B-L and 1B-CMZ for Damage Area 1B, we are concerned that Proposal 1B-L has cut off some land on the peninsula of the Brandywine near its confluence with the Christiana. This site includes land critical to the City's future growth and is, even now, undergoing further development. I am requesting that any proposals for this section consider flood relief of all lands adjacent to the Brandywine.

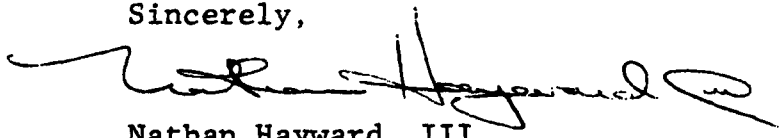
October 3, 1977

1. Alternatives involving the expenditure of public funds for flood proofing or acquisition of flood prone structures should be dropped from further consideration;
2. We feel that the Corps could provide valuable assistance to floodplain regulatory programs by providing the necessary information to accurately define and map the floodplain;
3. The development of building standards for floodplain construction would be helpful. This would be of value in situations where prohibition of floodplain occupancy would constitute a taking without just compensation; and
4. The study should continue to examine flood warning and emergency preparedness alternatives as well as regulatory controls designed to limit further floodplain development.

As a final note, this office is aware that the Corps is required to follow Water Resource Council guidelines when studying or designing water projects. Delaware has in the past objected to the philosophy underlying these guidelines, particularly with regard to the determination of eligible project benefits. Our comments on this, as well as several other recent Corps projects, have reflected this difference of opinion. Until such time as these guidelines are revised to reflect Delaware's position, or at least provide the flexibility to do so, a considerable amount of time, effort and money will continue to be spent on projects which have little chance of construction.

If you have any questions or would like to discuss this matter further, please do not hesitate to contact me. I hope these comments have been helpful.

Sincerely,



Nathan Hayward, III  
Director

NH/BC/np

cc: Joseph Biden, U.S. Senator, State of Delaware  
William Roth, U.S. Senator, State of Delaware  
Thomas Evans, U.S. Representative, State of Delaware  
Mary Jornlin  
Henry Folsom  
Richard Bauer  
Albert Madora  
Merna Hurd  
David Singleton  
Peter Marshall

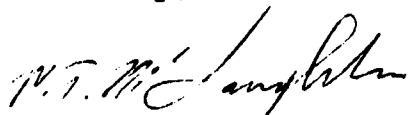
I would like to raise two other issues for consideration by this study. First, the City is having a severe problem with silting at the Port of Wilmington at the mouth of the Christiana River. I raise this because of dredging at the Port is a Corps responsibility and there may be a combined flood and silt relief project which could be of mutual benefit to the port and storm water management. Secondly, there has been a proposal to reduce flooding near the mouth of the Brandywine by cutting a new channel across the near neck of the peninsula. Again, I am requesting further study in and an opportunity for the City to provide additional economic information for this project.

While structural improvements are considered more viable to the City, nonstructural flood relief measures are also of interest. The City would be willing to participate in the costs of a flood forecasting and warning system at the cost levels indicated if it could be undertaken on a regional basis. The city is already involved in preparedness planning. Wilmington is also participating in the Federal Flood Insurance program, but would welcome additional technical information leading to more extensive flood insurance protection and flood plain zoning. Similarly, this data would improve the capability for flood proofing of structures, although the City finds it difficult to issue the necessary local assurances for participation on behalf of effected property owners. In summary, the City will support all efforts towards these nonstructural improvements.

The City is very interested in pursuing plans 1B-L and 1B-CMZ as presented in the attachment to your letter. Should further studies show that plans 1B-L and 1B-CMZ are feasible and suitable to the City, the City will provide all the required items of "local assurance" including land, easements, and right-of-way; a cash contribution for tidal flooding projects; and maintenance and operation of all works after construction in the amounts generally indicated on the draft fact sheets attached to your letter. The City is prepared now to undertake these activities but is discouraged by the long lead time for projects such as these. Since the development of projects will require many years, our commitment will have to be confirmed by future Mayors of the City.

In conclusion, I am excited by the possibilities outlined by your study and anxious to participate, and I am only discouraged by the time frame for implementation.

Sincerely,



W.T. McLaughlin  
Mayor

WTMcL/pl



DEPARTMENT OF THE ARMY  
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS  
CUSTOM HOUSE-2 D & CHESTNUT STREETS  
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-R

\*\*\*\*\*

\*COPY\*

\*\*\*\*\*

19 Oct 1977

Mr. Nathan Hayword III, Director  
Office of Management, Budgeting  
and Planning  
State of Delaware  
Thomas Collings Building  
Dover, DE 19901

Dear Mr. Hayword:

This concerns the termination of the flood control study conducted by this office for Little Mill Creek, located near the town of Elsmere, Delaware.

As mentioned in our recent letter to your office, completion of the study and construction of a Federal project were contingent upon financial participation by the State of Delaware. Since your letter of 3 August 1977 indicated that the State could not participate in this project, I had no alternative but to recommend to my higher authority that the study be terminated. The recommendation has been approved and the study is officially terminated.

Sincerely yours,

HARRY V. DUTCHYSHYN  
Colonel, Corps of Engineers  
District Engineer

Appendix 1

38





City of Wilmington, Delaware  
City/County Building 800 French Street 19801

WILLIAM T. McLAUGHLIN  
MAYOR

July 18, 1978

Mr. Paul Gaudini  
Department of the Army  
Philadelphia District Corps of Engineers  
Custom House - 2nd and Chestnut Streets  
Philadelphia, Pennsylvania 19106

Dear Mr. Gaudini:

As a follow up to our meeting with you on July 11, 1978,  
and as requested in your letter to me of June 21, 1978,  
please consider this letter a statement of reconfirmation  
of the City's support for Flood Control Project Plans  
1A-L2 and 1B-L.

If you require anything further, please contact me.

Sincerely,

A handwritten signature in cursive script that reads "Fred Brueggeman".

Fredrick Brueggeman  
Director  
Department of Planning and Development

FB:peg

Appendix 1  
39



DELAWARE STATE SENATE  
130TH GENERAL ASSEMBLY

SPONSOR Sens. Martin, Sharp, Holloway,

Knox, Arnold, Hahn, 1979  
Cicione, Medina,  
Reps. Plans, T. Brady, Smith,  
Sincock, McKay, Gilligan,  
Oberle, Neal, Anderson,  
Cain

SENATE CONCURRENT RESOLUTION NO. 9

RECOGNIZING THE WHITE CLAY CREEK AND ITS ENVIRONS AS ONE OF  
DELAWARE'S OUTSTANDING NATURAL RESOURCES AND CALLING FOR ITS PRESERVATION.

1 WHEREAS, the outstanding and diverse attributes of the White Clay Creek and its  
2 Valley have qualified it for inclusion among unique Natural Areas of Delaware; and

3 WHEREAS, the free-flowing stream of the White Clay Creek Valley is the foremost  
4 trout stream in the State of Delaware; and

5 WHEREAS, the State of Delaware and the City of Newark have existing proprietary  
6 interests in the White Clay Creek Valley; and

7 WHEREAS, the White Clay Creek Valley has been utilized by the University of  
8 Delaware for scientific studies in the biological, archeological, geological,  
9 hydrological, and engineering fields; and has traditionally been accessible to the  
10 Greater Newark Community for recreational pursuits compatible with its natural  
11 character such as hiking, biking, jogging, fishing, hunting, trapping, bird watching,  
12 nature study, picnicing, horseback riding, sledding, skiing, photography, swimming,  
13 floating, canoeing, ice skating, and others; and

14 WHEREAS, members of the Coalition for Natural Stream Valleys, Inc. and its  
15 associated organizations: the Delaware Group of the Sierra Club, the United Auto Workers of  
16 Delaware, the Delaware Nature Education Society, the Society of Natural History  
17 of Delaware, Delaware Wildlands, Inc., White Clay Creek Watershed Association,  
18 Christina River Environmental Effort Committee, Wilmington Trail Club, Delaware  
19 Wildlife Federation, and the Delaware Chapter of Trout Unlimited, have been promoting the  
20 protection and proper management of the White Clay Creek Valley and its resources  
21 for the better part of the past two decades.

22 NOW, THEREFORE:

23 BE IT RESOLVED by the members of the Senate of the 130th General Assembly  
24 of the State of Delaware, the House of Representatives concurring therein that it is  
25 strongly recommended to all Jurisdictions having a recognized interest in the White  
26 Clay Creek and its environs, that the resources of the White Clay Creek, the stream

Appendix 1

40

1 itself, the streambanks, the floodplains, the flood fringe, and the adjacent  
2 slopes and meadows, as it flows from the Pennsylvania state line to lands within  
3 and adjoining the City of Newark, be maintained in their near natural condition  
4 for the benefit and use of all present and future Delaware Citizens.

5 BE IT FURTHER RESOLVED that a copy of this Resolution be sent immediately  
6 to all concerned parties: Governor of the State of Delaware, Delaware Office of  
7 Management and Budget, Delaware Department of Natural Resources, Delaware  
8 Division of Fish and Wildlife, Delaware Division of Parks and Recreation,  
9 Delaware Department of Transportation, Mayor and Council of the City of Newark,  
10 County Executive and Council of New Castle County, Senator Joseph R. Biden,  
11 Senator William V. Roth, Congressman Thomas A. Evans, Environmental Protection  
12 Agency, U.S. Army Corps of Engineers.



City of Wilmington, Delaware  
City/County Building 800 French Street 19801

WILLIAM T. McLAUGHLIN  
MAYOR

January 28, 1981

Mr. D. J. Sheridan  
Chief  
Planning/Engineering Division  
Department of the Army  
Philadelphia District, Corps of Engineers  
Custom House, 2-D & Chestnut Street  
Philadelphia, PA 19106

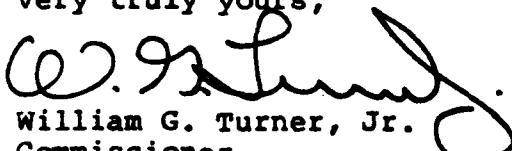
Dear Mr. Sheridan:

I am writing with reference to the series of discussions that have taken place regarding the proposed flood protection work along the Christina River in Wilmington.

After reviewing the magnitude of work required to meet standard flood protection requirements, the costs associated with that work, in conjunction with our firm commitment to reduce our outstanding debt, and our highest priority with the Corps being the continued dredging at the Port of Wilmington, we must, reluctantly, withdraw from further participation in this effort at this time.

I would like to express my appreciation for the studies on this matter compiled by the Corps. They will provide the basis for any future efforts to improve flood protection along the Christina River.

Very truly yours,

  
William G. Turner, Jr.  
Commissioner  
Department of Public Works

WGT/ch

CC: David W. Singleton, Administrative Assistant to the Mayor  
Donn Devine, Director of Planning

Appendix 1



United States  
Department of  
Agriculture

Soil  
Conservation  
Service

204 Treadway Towers  
9 E. Loockerman Street  
Dover, Delaware 19901

March 1, 1982

Mr. Nicholas J. Barbieri, P.E.  
Acting Chief, Planning/Engineering Division  
Department of the Army  
Philadelphia District, Corps of Engineers  
Custom House - 2D & Chestnut Streets  
Philadelphia, Pennsylvania 19106

Reference: NAPEN-P

Dear Mr. Barbieri:

This acknowledges receipt of the draft Metropolitan Christina River Basin  
Study, Pennsylvania and Delaware. We have no comments on the draft report.

Sincerely,

OTIS D. FINCHER  
State Conservationist

Appendix 1  
43



The Soil Conservation Service  
is an agency of the  
Department of Agriculture

SCS-AS-1  
10-79



WATER RESOURCES AGENCY  
FOR NEW CASTLE COUNTY

POLICY BOARD

New Castle County Executive  
Mayor, City of Wilmington  
Mayor, City of Newark  
Representatives, Municipalities and State  
With MAPCO Executive Director, Chairman  
With Administrator, Secretary

March 4, 1982

Mr. Nicholas J. Barbieri, P.E.  
Acting Chief, Planning/Engineering  
Division  
Department of the Army  
Philadelphia District, Corps of Engineers  
Custom House  
Second and Chestnut Streets  
Philadelphia, PA 19106

RE: Metropolitan Christina River Basin Study (NAPEN-P)

Dear Mr. Barbieri:

The Water Resources Agency for New Castle County would like to acknowledge receipt of the draft feasibility study for the Christina River Basin. Staff review of this document has resulted in general concurrence with the report conclusions.

If you have any further questions on this matter, please do not hesitate to contact this office.

Regards,

  
Bernard L. Dworsky  
Administrator

rbc

cc: Richard M. Bauer  
Albert W. Madora

Appendix 1

44



GERALD M. HANSLER  
EXECUTIVE DIRECTOR

DELAWARE RIVER BASIN COMMISSION  
P.O. BOX 7360  
WEST TRENTON, NEW JERSEY 08628  
(609) 883-9500

HEADQUARTERS LOCATION  
25 STATE POLICE DRIVE  
WEST TRENTON, N.J.

March 4, 1982

Mr. Nicholas J. Barbieri, P.E.  
Acting Chief  
Planning/Engineering Division  
U. S. Army Corps of Engineers  
Custom House  
2nd and Chestnut Streets  
Philadelphia, Pennsylvania 19106

Dear Mr. Barbieri:

We have reviewed your draft report on the Metropolitan Christina River Basin Study and understand that for the one alternative plan that showed economic and environmental feasibility for flood protection, lack of a non-Federal sponsor to assume the cost-sharing requirements has rendered it unimplementable.

We appreciate the opportunity to review and comment on the Christina Basin draft report.

Sincerely,

Gerald M. Hansler

Appendix 1  
45



# United States Department of the Interior

## NATIONAL PARK SERVICE

MID-ATLANTIC REGION  
143 SOUTH THIRD STREET  
PHILADELPHIA, PA. 19106

IN REPLY REFER TO:

L7619 (MAR)FE

MAR 5 1982

Mr. Nicholas J. Barbieri, P.E.  
Acting Chief  
Planning/Engineering Division  
Department of the Army  
Philadelphia District  
Corps of Engineers  
Custom House  
2nd & Chestnut Streets  
Philadelphia, Pennsylvania 19106

Dear Mr. Barbieri:

In response to your letter of February 26, 1982 we have reviewed your draft feasibility report on the Christina River Basin Water Resources Study. It appears that your findings and conclusion will present no difficulty to any programs of the National Park Service.

Sincerely,

Don H. Castleberry  
Acting Regional Director





DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT  
PHILADELPHIA REGIONAL OFFICE  
CURTIS BUILDING, SIXTH AND WALNUT STREETS  
PHILADELPHIA, PENNSYLVANIA 19106

REGION III

IN REPLY REFER TO:

MAR 9 1982

Mr. Nicholas J. Barbieri, P.E.  
Acting Chief  
Planning/Engineering Division  
Philadelphia District, Corps of  
Engineers  
Custom House  
2nd and Chestnut Streets  
Philadelphia, Pennsylvania 19106

Dear Mr. Barbieri:

This is to acknowledge our receipt of the findings contained in the draft report of the Metropolitan Christina River Basin Study. We have no comments to offer.

Thank you for the opportunity to review this document.

Sincerely,

*Thomas J. Gola*  
Thomas J. Gola  
Regional Administrator

Appendix 1

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AREA OFFICES

Baltimore, Maryland - Philadelphia, Pennsylvania - Pittsburgh, Pennsylvania - Richmond, Virginia - Washington, D.C.



DEPARTMENT OF HEALTH & HUMAN SERVICES

Office of the Principal  
Regional Official

Region III  
P.O. Box 13716, 3535 Market St.  
Philadelphia, PA 19101

MAR 9 1982

Mr. Nicholas J. Barbieri  
Acting Chief, Planning/Engineering Division  
Philadelphia District, Corps of Engineers  
Custom House - 2nd & Chestnut Streets  
Philadelphia, PA 19106

Dear Mr. Barbieri:

Thank you for the opportunity to review the draft of the Metropolitan Christina River Basin Study Report. We note that the conclusions indicate that your recommendation will be no Federal involvement in providing flood control measures in the basin. In view of the negative aspects of your findings, this agency has no comment at this time.

Sincerely yours,

*Linda Z. Marston*  
Linda Z. Marston  
Regional Director



# Federal Emergency Management Agency

Region III 6th & Walnut Streets Philadelphia, Pennsylvania 19106

March 10, 1982

Mr. Nicholas J. Barbieri, P.E.  
Acting Chief  
Planning/Engineering Division  
Philadelphia District  
U. S. Army Corps of Engineers  
Custom House - 2nd & Chestnut Streets  
Philadelphia, PA 19106

RE: Metropolitan Christina  
River Basin Study

Dear Mr. Barbieri:

We have reviewed the above referenced document and have found no  
need to comment.

Sincerely yours,

John Wm Brucker  
Regional Director

city  
of NEWARK

post office box 390 / newark, delaware 19711 / telephone 302-366-7000

CITY COUNCIL  
MAYOR  
COUNCIL

1st DISTRICT  
2nd DISTRICT  
3rd DISTRICT  
4th DISTRICT  
5th DISTRICT  
6th DISTRICT

CITY MANAGER  
CITY SECRETARY

William M. Redd, Jr.  
John R. Suchanec  
William M. Coverdale  
Richard D. Lash  
Edwin H. Nutter, Jr.  
Harold A. Enger  
Olan R. Thomas  
Peter S. Marshall  
Betty J. Stiltz

Writer's Direct Dial Number: (302) 366- \_\_\_\_\_

March 15, 1982

Nicholas J. Barbieri, P.E.  
Acting Chief  
Planning/Engineering Division  
Department Of The Army  
Philadelphia District Corps of Engineers  
Custom House - 2nd & Chestnut Sts.  
Philadelphia, Pennsylvania 19106

Dear Mr. Barbieri:

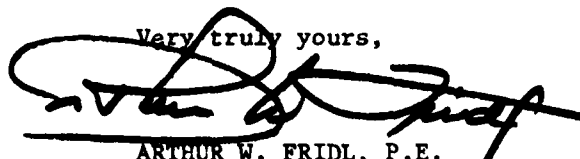
Reference your letter of 26 February 1982, which forwarded the draft Feasibility Report on the Metropolitan Christina River Basin.

We found the report to be very informative and it showed that a great deal of time and effort was put into it.

We have no suggestions for additions or changes. There is the possibility, however, that we would take advantage of your offer to obtain hydrologic, hydraulic and other technical information as it pertains to that area of the Christina in which we are most interested.

Thank you very much for sending us a copy of the report.

Very truly yours,



ARTHUR W. FRIDL, P.E.  
DIRECTOR, PUBLIC WORKS DEPARTMENT

AWF:mlk



UNITED STATES  
DEPARTMENT OF THE INTERIOR  
FISH AND WILDLIFE SERVICE  
DELMARVA AREA OFFICE  
1825 VIRGINIA STREET  
ANNAPOLIS, MD 21401

March 15, 1982

District Engineer  
Philadelphia District, Corps of Engineers  
Custom House-2 D & Chestnut Streets  
Philadelphia, PA 19106

Dear Col. Baldwin:

This is to acknowledge receipt of your draft report for the Metropolitan Christina River Basin Study. We understand, and take no exception to the report finding, namely that no feasible federal flood control plans were identified.

We appreciate being informed regarding the result of this study.

Sincerely yours,

John D. Green  
Area Manager





COMMONWEALTH OF PENNSYLVANIA  
DEPARTMENT OF ENVIRONMENTAL RESOURCES  
P.O. BOX 1467, HARRISBURG, PENNSYLVANIA 17120



717-787-6750

March 18, 1982

In reply refer to  
RM-R  
F 15:3

Nicholas J. Barbieri, Acting Chief  
Planning/Engineering Division  
Philadelphia District - Corps of Engineers  
Custom House - Second & Chestnut Streets  
Philadelphia, Pennsylvania 19106

Dear Mr. Barbieri:

This will acknowledge receipt of the Draft Feasibility Report,  
Metropolitan Christina River Basin, mailed 26 February 1982 to  
Secretary Duncan.

We concur in your sentiment that it is regrettable that no projects  
could be implemented on the basis of the study. We hope the information  
base can be of some aid to municipalities in the future.

Thank you for keeping this office informed during the course of  
the study.

Sincerely,

  
John E. McSparran, Director  
Bureau of Resources Programming



# Department of Planning

OFFICE OF THE DIRECTOR

2701 Capitol Trail  
Newark, Delaware 19711

(302) 366-7780

March 25, 1982

Mr. Nicholas J. Barbieri, P.E.  
Acting Chief, Planning/Engineering Division  
Department of the Army  
Philadelphia District, Corps of Engineers  
Custom House  
Second and Chestnut Streets  
Philadelphia, Pennsylvania 19106

RE: Metropolitan Christina River Basin Study (NAPEN-P)

Dear Mr. Barbieri:

The New Castle County Department of Planning appreciates the opportunity to review the draft feasibility study for the Christina River Basin. Based upon the staff review of the document, this Department is in general concurrence with the report's conclusions.

The Department will be further reviewing two projects, i.e., Alternative 20-CM and the Little Mill Creek Channel Improvement under the auspices of the Small Projects Flood Control Program. The Department will be coordinating this effort with Mr. Larry Irelan, Director of the Division of Soil and Water Conservation, State of Delaware.

If you have any further questions, please feel free to contact this Department.

Sincerely,

Richard M. Bauer  
Director of Planning

EO'D/daj

cc: Richard T. Collins  
Albert W. Madora  
Warren S. O'Sullivan  
Bernard L. Dworsky  
Laurence Irelan

STOP A CRIME -- SAVE A LIFE -- DIAL 911  
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Appendix 1  
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STATE OF DELAWARE  
DEPARTMENT OF NATURAL RESOURCES  
& ENVIRONMENTAL CONTROL

EDWARD TATNALL BUILDING  
P.O. BOX 1401  
DOVER, DELAWARE 19901

OFFICE OF THE  
SECRETARY

PHONE: (302) ~~878~~ 4403  
736

March 29, 1982

Mr. Nicholas J. Barbieri, P.E.  
Acting Chief, Planning/Engineering Division  
Department of the Army  
Philadelphia District, Corps of Engineers  
Custom House  
2nd and Chestnut Streets  
Philadelphia, Pennsylvania 19106

RE: Metropolitan Christina River Basin Study (NAPEN-P)

Dear Mr. Barbieri:

We have reviewed your draft feasibility study for the Christina River Basin and agree with the general conclusions.

After discussions with New Castle County Department of Planning representatives, there are two projects that we would like to examine further under the Small Projects Flood Control Program. They are Alternative 20-CM channel modification near Penn Central Railroad bridge and Alternative at Damage Center 27, Little Mill Creek.

We appreciate this opportunity to review the document and will look forward to working with your small projects people. They should coordinate their effort with Mr. Laurence R. Irelan, Director of the Division of Soil and Water Conservation, State of Delaware, Tatnall Building, P. O. Box 1401, Dover, Delaware, 19901.

Sincerely,

John E. Wilson, III  
Secretary

JEW:LRI:elm

Appendix 1





UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION III

6TH AND WALNUT STREETS  
PHILADELPHIA, PENNSYLVANIA 19106

March 30, 1982

Mr. Nicholas J. Barbieri  
Acting Chief, Planning/Engineering Division  
Philadelphia District  
Corps of Engineers  
U.S. Custom House  
2nd & Chestnut Streets  
Philadelphia, PA 19106

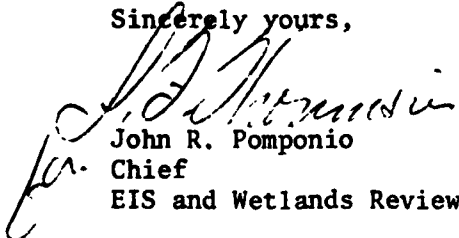
Re: Metropolitan Christina River Basin Study, Pennsylvania and  
Delaware, February 1982.

Dear Mr. Barbieri:

We have reviewed the referenced study which identified flood damage alternatives in the Christina River Basin. Based upon a lack of local support and economic justification, the Corps would not provide flood protection. We concur with the Corps' findings and should note that we also favor flood zoning and forecasting over stream modification where appropriate.

Thank you for the opportunity to comment on this study.

Sincerely yours,

  
John R. Pomponio  
Chief  
EIS and Wetlands Review Section



**UNITED STATES DEPARTMENT OF COMMERCE**  
**National Oceanic and Atmospheric Administration**  
NATIONAL WEATHER SERVICE  
Silver Spring, Md. 20910

April 22, 1982

Mr. Nicholas J. Barbieri, P.E.  
A/Chief, Planning/Engineering Division  
U.S. Army Corps of Engineers  
Philadelphia District  
Custom House - 2nd and Chestnut Streets  
Philadelphia, PA 19106

Dear Mr. Barbieri:

The draft Metropolitan Christina River Basin Study, Pennsylvania and Delaware, has been reviewed by the National Weather Service (NWS) as requested in the memorandum NAPEN-P dated February 26, 1982. Please send to Mr. Albert Kachic, NOAA/NWS Eastern Region, 585 Stewart Avenue, Garden City, NY 11530, six additional copies for distribution to our field offices.

Alternative FW-1, Flood Forecasting, Flood Warning and Preparedness Planning of the Study indicates a benefit/cost ratio of 6.3. Because of this high BCR, the NWS will further investigate community interest and the feasibility of developing and implementing a local self-help forecast and warning program with the local communities and counties involved.

The NWS Self-Help Community Flood Forecast and Warning Program has a wide range of options from a manual volunteer rainfall network and forecasts system to a computer-based observational forecast and warning system.

The advanced system, Automated Local Evaluation in Real-Time (ALERT) utilizes self-reporting automatic radio rain gages and river gages. Observations are radioed to a central site where a minicomputer monitors the incoming data and produces a flood forecast. When certain threshold values of rainfall or river depths are surpassed, the forecast program automatically activates a message of flood conditions.

A local self-help forecast and warning system combined with a community preparedness program and an interested and cooperative citizenry can help reduce flood damages as much as 30 percent.

The NWS's function will be to present the various options, work with the state, county or local communities in selecting the option, develop the flood forecast model, and train the local assigned personnel in its operation and use. The community would be responsible for purchasing, installing, maintaining, and operating the network in cooperation with the National Weather Service.



If there is no local interest, the NWS will also terminate further efforts in the flood forecast and warning area.

Sincerely yours,



Robert A. Clark  
Associate Director  
National Weather Service (Hydrology)

cc:  
MIC WSFO Phila.  
MIC, WSO Wilmington  
J. Talley, DE, USGS  
A. Kachic, WFE2

END

FILMED

DTIC